• 15P0059B3 •

DCREG2
DCREG4

USER MANUAL

15/07/08 R.06
SOFTWARE VERSION D5.00 ...

English

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SANTERNO
GRUPPO CARRARO

Elettronica Santerno S.p.A.
Strada Statale Selice, 47 - 40026 Imola (BO) Italia
Tel. +39 0542 489711 - Fax +39 0542 489722
www.elettronicasanterno.com sales@elettronicasanterno.it

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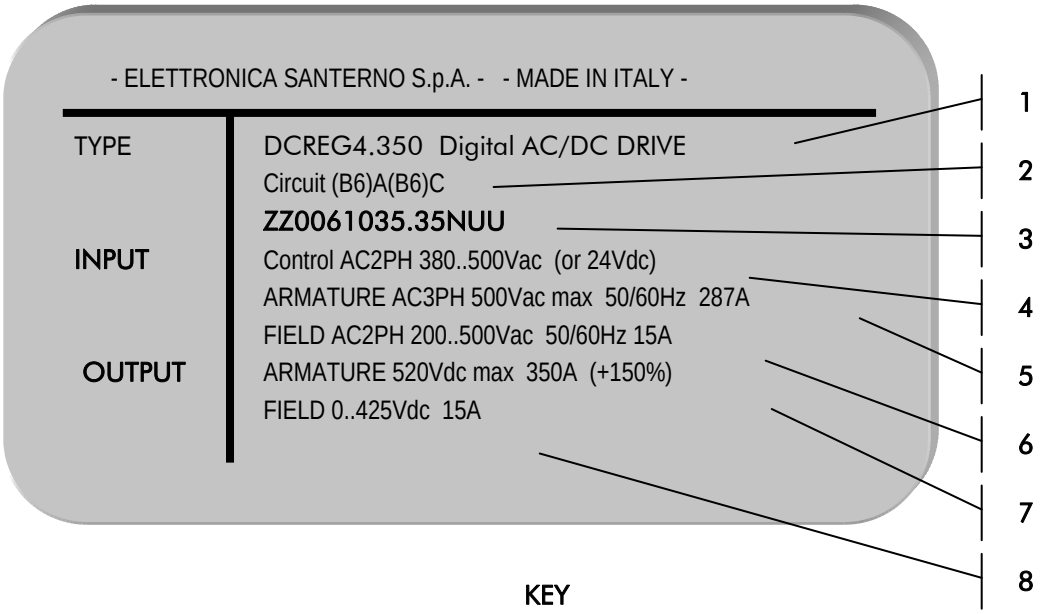
1 DELIVERY CHECK

When receiving the unit, check that no damage is visible and its compliance with your requirements. To do that, refer to the plate (see following figure) located on the converter front side. If the unit is damaged, contact the insurance company or the supplier.
If the unit is stored before it is used, check that the storage area conditions are acceptable (temperatures ranging from -20°C and +60°C, relative humidity lower than 95% and no dew).
The warranty covers any manufacturing faults. The manufacturer has no responsibility for damages occurred during transportation or unpacking.
In no case and in no circumstances, the manufacturer will be responsible for damages or failures due to wrong usage, abuse, wrong installation or incorrect temperature, humidity or corrosive materials, as well as for faults caused by operation exceeding the rated values. The manufacturer will not be responsible for consequential or accidental damages.
The manufacturer provides a 12-month warranty, starting from the delivery date.



1. The device is called DCREG4.350. It is an AC/DC digital-operated drive.
2. The acronym identifies the configuration consisting of two full-control three-phase bridges in antiparallel forming the drive power section.
3. The device main code and size code are detailed before and after a full stop respectively (ELETTRONICA SANTERNO codes).
4. The control section may be supplied either with 380 … 500Vac single-phase alternate voltage or with a 24Vdc direct voltage (considering, of course, a different terminal pair).
5. The armature section can be supplied with a 500Vac (max.) three-phase alternate voltage and according to a 50/60Hz frequency value, thus absorbing at rated load a three-phase alternate current equal to 287A.
6. The field section may be supplied with a single-phase alternate voltage equal to 200 … 500Vac and according to a 50/60Hz frequency value, thus absorbing at rated load an alternate current equal to 15A.
7. The device is able to supply 520Vdc (max.) on the armature output, with continuous supply of 350A (with a maximum overload of 150% of the nominal value at a preset duty-cycle).
8. The device is able to supply 425Vdc (max.) on the field output, with a continuous supply of 15A.

NOTE Any DCREG manufactured starting from the second half of 2008 is equipped with one ES906 control board instead of ES800 + ES801 control boards.

2 START-UP

2.1 INTRODUCTION

This section describes the main checks and operations which should be carried out to achieve an excellent adjusting of the DCREG drive.
All information contained herein is directed to the Users being already familiar with the use of the keypad. If need be, refer to the KEYPAD AND ALPHANUMERIC DISPLAY section for further information.
For a clearer drive operation, the drive operating mode is supposed to send references and control sequence to inputs by means of the terminal board.
This section has to be considered as a simple and useful guide aimed at achieving a proper adjusting of the device. It covers both the regulations regarding the most common applications and the setting up of more specific configurations.
For further information about the function of the different hardware terminals or software parameters and any additional details, refer to the specific sections of the manual.
In particular, it is strongly recommended to refer to the POWER CONNECTIONS and SIGNAL CONNECTIONS sections for a correct use of the hardware terminals, as well as the BLOCK DIAGRAM and the PARAMETER LIST section for a proper setting of the software parameters.

2.2 PRELIMINARY CHECKS

2.2.1 When installing the equipment, carefully read the information given on the stick-on plate fitted on the front panel and make sure that the supply voltage value required to supply the **power section** at bars L1-2-3 does not exceed the maximum value advised (standard value: 440Vac for DCREG2 and DCREG4). Check also that the supply voltage for the **field regulator** on terminals E1-2 and for the **control section** on terminals 53-54 is included within the suggested range.
Of course, the latter requirement shall not be necessary whenever the user is going to supply the control section with a 24Vdc direct voltage on terminals 40-42. This is always possible even without making any hardware modification.

NOTE

The standard equipment may be supplied on **terminals 53-54 (control section)** with a single-phase alternate voltage between 380 … 500Vac. On demand, the device may be supplied on terminals 53-54 a with single-phase alternate voltage between 200 … 240Vac.

The standard equipment may be supplied through **terminals E1-2 (field regulator)** with a single-phase voltage ranging from 200 to 500Vac. For drives assembled till 30th June 2006 only, in order to supply terminals E1-2 with a single-phase alternate voltage ranging from 200 to 240Vac, just enable jumper J1 on field regulator board ES734 in position *"230 ON"*.

2.2.2 Check also that the **device** is not oversized compared to the motor rated current. That means that the motor current value should not be lower than the 75% of the device rated current.

2.2.3 Carefully inspection the **wiring** by referring to the POWER CONNECTIONS and SIGNAL CONNECTIONS sections of this manual. In particular, make sure that a NO auxiliary contact of the KM contactor has been connected in series with the *ENABLE* contact on terminal 24.

2.2.4 Connect the shield of the screened cables relating to the analog signals to the ground potential as directly as possible. Use the three collar-shaped cable fasteners situated on the bottom of the control board supporting guard.

2.3 MAIN CHECKS AND CONFIGURATIONS

2.3.1 Supply the **control section** and the **field regulator** of the device (except the power section). The four LEDs which can be seen through the small rectangular slot on the cover should be off.

NOTE

Whenever the display shows an **alarm** condition, it is necessary to **reset** it by simultaneously pressing the "PROG" and "SAVE" keys on the front keypad, or by means of one of the configurable digital inputs, by programming **parameters C130(131)(132)(133)(134)(135)** at the *0:Reset* value (this configuration is a default value on *MDI1*, terminal 28). Should the alarm not disappear from the display (and therefore the alarm cause persists), refer to the ALARM PARAMETERS section of the manual.

NOTE

Before **changing** the above mentioned parameters and any other parameter, set the value of **parameter P000** to 1.

NOTE

Any other setting up procedure described below should always be **saved on the EEPROM**. The non-observance of said instruction shall produce the loss of all data while turning off the device.

NOTE

The **programming level** is set in **parameter P003**; its default value is called *0:Basic*. This parameter allows to access and modify few other parameters only, as it is used for a quick and simple starting. If during the start-up procedure some parameters which are not included in said programming level must be changed, set parameter P003 to *1:Advanced*.

2.3.2 When no alarm condition is stored, the display generally keeps on showing the *Status* page, unless the *KeyPad* page has been programmed through parameter P004 (*FirstPage*). When no alarm condition is stored, the *Status* page displays the **Drive OK** message, the software version which has been installed, the drive type, the drive size and the max. supply voltage that may be applied to the power section. Otherwise, the Alarms and Warnings are displayed on this page.
Here follows an example of such displaying messages.

```
Drive OK - D4.01
DCREG4.100   P440
```

By the example stated above, we understand that no alarm conditions are detected, that the installed software version is D4.01, and that the device is a DCREG4 with continuous output current equal to 100A and a maximum three-phase voltage applicable to the power section equal to 440V.

NOTE

The displaying of **warning message W003** (*Imax[T2] <100%*) means that it is necessary to turn the T2 trimmer completely clockwise, since a partial rotation clockwise could result in a disagreement between the current limit and the armature maximum current values to be obtained. More precisely, the armature maximum current value could be lower than the one required.
The trimmer is located on the right side of the ES800 (ES906) board, near the two seven-segment displays which can be seen through the small slot on the drive cover.

2.3.3 Check the correct operation of the **air-cooling unit** (if any). Air blowing should be generated from the bottom to the top.

2.3.4 The device is already supplying the motor **field** winding, according to the economy function (Field Economy) set in par. C014.
On **parameter C010** (default value: 10%), set the **field rated current** percentage of the motor with respect to the field rated current of the drive. The standard values of the drive field rated current are 5A for DCREG.100max.,15A for DCREG.150min Size 1 and 35A for DCREG Size 2(A) and MODULAR.S.
If need be, you can also change the **standstill field current on parameter C014** (default value: 10% of C010) and the **field decrease delay** on **parameter C015** (default value: 240s).
If a ***boost* on the field current** is to be set at the device starting, adjust the value of **parameter C017** (default value: 100%) and **parameter C018** (default value: 10s) accordingly by enabling the function through one of the configurable digital inputs; set **parameters C130(131)(132)(133)(134)(135)** to the *11:FldFrcEnabled* value. This, however, could have no effect if the field current increase does not produce any remarkable field flux increase, thus limiting this function application.

2.3.5 If a dynamic regulation of the field current in **field weakening** mode is required - with a speed feedback **different** than the armature feedback - besides programming **par. C010** and **C014**, program the motor armature nominal voltage in **par. C012** (default value: 1000V), **the value per cent of the field weakening start max. speed** in **par. C011** (default value: 33%) and the **limit at the field current min. value** in **par. C016** (default value: 25% of C010).
As stated in the FIELD REGULATOR chapter, set the last value at approx. 75% of the min. motor rated field current corresponding to its max. speed.

2.3.6 Make sure that the rated value of the **power section supply voltage** corresponds to the indications stated in **parameter C030** (default value: 400V): if necessary, change the value.

2.3.7 Access **parameter C000** (default value: 100%) and set the percentage value of the **armature rated current** of the motor with respect to the armature rated current of the drive.
If need be, also set a proper **thermal constant** on **parameter C002** (default value: 300 s) by following the general indications described in the chapter of this manual dealing with that parameter.

2.3.8 Choose the **operating mode of the current loop** through **parameter C051** (default value: PI). It is advised to leave the default selection of C051 at value *0:PI Operating* in most cases, and to set C051 selection at value *1:Predictive=>J1* only when a very quick response is demanded with a DCREG4 in encoder or tacho feedback mode, unless the load inertial torque is much lower than the resisting torque.

2.3.9 When choosing the second mode (predictive algorithm), set jumper J1 from position 1 to position 0. Jumper J1 is located on board ES729/1 (installed inside the equipment on control board ES728/2), then perform **current autotune** and set parameter **P001** to value *1:Current* and follow the instructions displayed (see also the AUTOMATIC TUNING section). By contrast, if the first modality (PI regulator) is chosen, go on with the next step of this Procedure.

2.3.10 Access **parameter C070** (default value: Tacho feedback: 80 ... 250V) and make sure that the **speed feedback** type which has been set corresponds to the one required.

2.3.11 Should the feedback be generated from a **tacho**, check the value set on C070 (among values 0-1-2), which should match the terminal being used to receive the signal from the tacho.
Then, if the tacho **transduction ratio** set on **parameter C074** (default value: 60V / 1000 RPM) is correct, set the **speed concerning the maximum reference** in **parameter P010** (default value: 2500RPM) in r.p.m.

NOTE

Any value being set for parameters C074 and P010 should be programmed in such a way that product C074•P010 does **not exceed 25V if C070 = 0, 80V if C070 = 1, 250V if C070 = 2**. Otherwise, this will cause drive speed control failure.

2.3.12 Should the feedback be generated from an **encoder**, check that the **transduction ratio** of the supplied signal, which has been set on **parameter C072** (default value: 1024 pulses/rev) is correct. If necessary, change it accordingly.
The **speed concerning the maximum reference** (expressed in r.p.m.) should always be set on parameter P010 (default value: 2500RPM).

NOTE

Any value being set in parameters C072 and P010 should be programmed in such a way that product C072•P010 does **not exceed 102.400kHz** (value obtained from an encoder supplying 1024 pulse/rev that can rotate at a speed of max. 6000 RPM: $102400 = \frac{1024 \cdot 6000}{60}$), in order to avoid possible speed control faults caused by the drive.

2.3.13 Should the feedback be generated from an **armature**, set on **parameter P011** (default value: 400V for DCREG4, 460V for DCREG2) **the armature voltage corresponding to the maximum value** (in Volt).

2.3.14 Except for a DCREG2 model, a DCREG4 model with an armature feedback or whenever the load inertial moment is largely variable (e.g. in a coiler), the **speed automatic tuning** may be performed at that moment. Set parameter **P001** to value *2:Speed* and follow the instructions displayed (see also the AUTOMATIC TUNING section).

2.3.15 Now **RxI armature resistive drop autotuning** is to be done by setting **par. P001** to *3:RxI* and following the instructions displayed (see also AUTOMATIC TUNING chapter). On the other hand, if the autotuning function is not performed and par. P088 is left at its default value (0V), the drive will not be able to process the back-electromotive force and to display it in par. M007 *(BEMF)* and it will not be able to keep the BEMF constant during the dynamic adjustment of the field current in field weakening mode or in armature feedback stage (by means of the compensation function to be done through parameter P86, with a value defined as a percentage of par. P088 value).

2.4 SPEED CONTROL MODE OPERATION

2.4.1 The previous section MAIN CHECKS AND CONFIGURATIONS has already covered the programming procedure of the speed corresponding to the maximum reference, as far as the three main types of speed feedback (tacho, encoder, armature) are concerned.
As for the analog inputs, **main input *REF*** between terminals 5 and 7 is generally used (in common mode, in differential mode, or by sending a 0(4) ... 20mA reference after adjusting jumper JP7 of board ES801 (JP407 in ES906) in pos. 2-3). The ramp function may be applied to said input.
Alternatively, it is possible to use **input *IN 1*** between terminals 11 and 13 (in common mode, in differential mode, or by sending a 0(4) ... 20mA reference after adjusting jumper JP8 of board ES801(JP408 in ES906) in pos. 2-3).
You can finally use **input *IN 2*** between terminal 17 and 0V or **input *IN 3*** between terminal 19 and 0V.

NOTE

Whenever a **(0)4 ... 20mA reference** is to be used, refer to the chapter dealing with MILLIAMPERE INPUT/OUTPUT SIGNALS to know the value to be programmed in the parameters relating to the *Gain* and *Bias* operators.

ATTENTION

Make sure that, at maximum speed and maximum voltage, the **output armature voltage** does not exceed the motor rated value.

NOTE

The **operation stability** is generally more critical when the speed maximum value being set according to the maximum reference decreases. In order to set **maximum speed values being especially low**, it is therefore recommended to reduce the reference amplification through the Gain function relating to the selected analog input (see the SPEED CONTROL OPTIONS chapter), instead of adjusting the feedback.

2.4.2 The value of the **reference for the jog run (jog)** may be chosen among the three values set on **parameters P222 ... P224** (default values: +5 %,-5 % and 0 % respectively), while the set value should be selected via a combination of two ***MDIx*** configurable digital inputs (max.) by programming **parameters C130(131)(132)(133)(134)(135)** at values *12:JogA* and *13:JogB* (these configurations are both default values on *MDI2* on terminal 30 and on *MDI3* on terminal 32 respectively: see the table reported in the chapter dealing with parameters P222 ... P224).

2.5 RAMP CONFIGURATION IN SPEED CONTROL MODE

2.5.1 The reference applied to the ramps will be indicated in the following chapters of this Manual (and in the BLOCK DIAGRAM) as *Ref n*. **For this *Ref n*, some ramp times may be programmed**; set the value on **par. P030 ... P035** (default values: 0s) or set the **roundings** through **par. P038** and **P039** (default values: 0s).

NOTE

Between ramp times and rounding times, a certain ratio of inequality should be proved. Said value is reported in the note in chapter RAMPS OVER REFERENCE.

2.5.2 On the other hand, the **jog run ramps** are indicated by **parameter P221** (by default, they have also been applied to the *Ref n* reference) and, depending on the parameter setting, may also be indicated by **parameters P030 ... P035** (default values: 0s) or by **parameter P036** and **parameter P037** (default values: 0s).

2.5.3 The **ramp and rounding times**, indicated by parameters P030 ... P035, P038, P039, may also be changed in continuous mode from the outside, through one of the configurable analog inputs. To do that, set **parameters C120(121)(122)** to one of values *3:Ramps reduct.* ... *7:tDN-reduction*, otherwise they may be set to zero through one of the ***MDIx*** configurable digital inputs by programming **parameters C130(131)(132)(133)(134)(135)** to *7:Ramps Disabled*..

2.5.4 In case of medium-duration ramps, set the **integral time automatic increase** during ramp through **par. P085** (disabled by default).

2.6 SPEED CONTROL OPTIONS

2.6.1 The signal entering analog inputs *REF, IN1, IN2, IN3* may be set with the following operators: ***Gain*** (with **parameter P122, parameter P128, parameter P131** and **parameter P134** respectively, default values: 100%), ***Bias*** (with **parameter P121, parameter P127, parameter P130** and **parameter P133** respectively, default values: 0%) and ***Polarity*** (with **parameter P120, parameter P126, parameter P129** and **parameter P132** respectively, default values: Bipolar). All these four inputs may be assigned to the ***Reverse*** operator (by means of programmable digital inputs ***MDIx,*** by setting **parameter C130(131)(132)(133)(134)(135)** at *5:Reverse*. This is the default configuration for MDI6 on terminal 38).
If the *LOC SEQ* LED is on or flashing, polarity may also be reversed by pressing the "REVERSE" key.
The internal reference, resulting from the application of the operators above, is displayed by par. M014, M010, M011 and M012 respectively.

2.6.2 In order to obtain the *Ref n* reference applied to the ramps, it is possible to choose one of the **preset run references** (up to a maximum of seven) **preset in parameters P211(212)(213)(214)(215)(216)(217)** (default values: +5 %, + 20%, +10 %, 0 %, -5 %, -20 %, -10 % respectively). To do so, select the reference concerned with a combination of max. three ***MDIx*** configurable digital inputs, by programming parameters **C130(131)(132)(133)(134)(135)** at values *1:Preset Speed A, 2:Preset Speed B* and *3:Preset Speed C* (see the table contained in the chapter dealing with parameters P211 ... P217: the *1:Preset Speed A* function is programmed by default on *MDI4*, terminal 34). The above mentioned ***Reverse*** function may be applied to these preset running references too. By introducing a preset running reference, the *START* contact closing is always required.

2.6.3 For the ***Ref n* speed reference** applied to the ramps, the user may select the **allowable polarity** through **par. P012** (default value: Bipolar). For said reference, the **maximum value** may also be defined through **parameter P013** and **parameter P015** (default values: +100% and -100% respectively). This limit is also valid for the *n setpoint* global reference. After programming a polarity of one sign only on parameter P012, a **minimum speed** value is given both for the *Ref n* reference applied to the ramps and for *n setpoint* global speed reference through **p. P014** and **p. P016** (default values: 0%). Anyway, disabling of minimum speed can be achieved by closing one of the ***MDIx*** configurable digital inputs, once **parameters C130(131)(132)(133)(134)(135)** have been programmed at value *9:MinSpdDisabled*.

2.6.4 In case of tacho or encoder feedback, and in the event of a feedback signal failure, it is possible to set the **automatic switching towards the armature feedback** through **par. C155** (default value: Alarm enabled).
If the dynamic regulation of the field current in **field weakening** mode is enabled, **par. P011** (default value 400 V) is to be set at the same value as par. C012 in order to keep the speed of rotation nearly constant in case of feedback failure.

2.6.5 In case of armature feedback, **the RxI drop compensation** may be entered through **par. P086** (default value: 100%) whose value represents the value per cent of par. P088 computed by the autotuning function. The autotuning function may be enabled by setting par. P001 to *3:RxI*.

2.6.6 Should the motor tend to turn slowly with a zero reference, i.e. when a **speed error offset** is detected, it is possible to stop the motor by adjusting **parameter P087** (default value: 0%).

2.6.7 A **limitation of the firing angle value** may be obtained both in the energy transfer towards the load and in the energy regeneration towards the mains. Set **parameter P230** (default value: 30° for DCREG4 and 25° for DCREG2) and **parameter P231** (default value: 150°) respectively.

2.6.8 To avoid possible speed overshoots due to quick variations of reference at constant load (drive in current limit mode), or to avoid temporary speed losses in case of quick variations of load at constant reference, it may be advisable to introduce the **parameter auto adaptation** (this function has been disabled by default) through **parameter P082** and any other related parameter. Refer to the SPEED PARAMETER AUTOADAPTATION chapter to know the different programming procedures required.

2.7 CURRENT (TORQUE) CONTROL MODE OPERATION

2.7.1 A current control (torque) is generally required when tension controls are performed on a winding or unwinding material or while controlling any machine integral to another from a mechanical point of view. In fact, said conditions require a proper torque distribution.

2.7.2 In the first event, a simple **external regulation of the current limit** is generally requested by using one of the configurable analog inputs; set **parameters C120(121)(122)** to one of values *8:Ext. curr.lim. ... 10:BrdgB ext.lim*. The polarity of the used signal may be selected on **par. P126(129)(132)** (default value: Bipolar).

NOTE

For this operating mode, the **speed reference** should allow to keep the drive in current limit condition at any time.

2.7.3 In the second case, a direct **setting of the current reference** is generally performed. To use the *REF* main input between terminals 5 and 7 it is then possible to program parameter C050 as *3:Iref=Vref* (default value: PI operating) whenever a permanent configuration is required. Otherwise, it could be advisable to close one of the ***MDIx*** configurable digital inputs by programming **parameters C130(131)(132)(133)(134)(135)** at value *6:Slave Enabled* whenever the current reference setting is to performed only through an external command enabling.

NOTE

A **current reference** setting may be performed on any *REF, IN1, IN2, IN3* analog inputs, after programming them accordingly.
In particular, if the *REF* main input between terminals 5 and 7 is to be used, the *Gain*, *Bias* and *Polarity* operators use **distinct parameters** (i.e. different from the parameters enabled in case of voltage / speed reference). In particular, the ***Gain*** function is programmed in **parameter P125**(default value: 100%), the ***Bias*** function is programmed in **parameter P124** (default value: 0%), while the ***Polarity*** function is programmed in **parameter P123** (default value: Bipolar).
By contrast, if auxiliary analog input *IN 1(2)(3)* is to be used, parameter **C120(121)(122)** is to be set at value *2:I loop add. ref*. In addition, main reference *REF* is to become a current reference, either permanently by programming parameter C050 at value *3:Iref=Vref* or temporarily by closing a digital input set at value *6:Slave Enabled*. For each of those two modes, main input *REF* is to be **connected to zero volt.**

NOTE

For a drive couple operating in MASTER / SLAVE mode, the current reference to be supplied by the master drive may be obtained on terminal 8(10) by programming P150(153) = *4:Current ref*. As the reference standard level supplied by the MASTER drive is 5V at its rated current (M003 = 100%), if also the SLAVE drive must supply its rated current - with said reference at *REF* main reference between terminals 5 and 7 - gain P125 *(IrefGain)* is to be set at 200%.

2.8 CURRENT LIMIT CONTROL OPTIONS

2.8.1 In the speed and current control, the **current internal limitation** remains always activated. It is generally set as **single-value adjusting** through **parameter P050 and parameter P051** (default values: 100%) and always represents a percentage of the armature current rated value indicated by **parameter C000** (default value: 100%).
So, whenever a **double-value adjusting** is required, it is necessary to set also **parameter P052** and **parameter P053** (default values: 100%) by fixing the switching speed threshold with **parameter P054** (default value: 100%).
If an **hyperbolic adjusting** is to be programmed, set **parameter P055**, **parameter P056** and **parameter P057** (default values: 100%).

2.8.2 A **current overlimit** (i.e. a permanent increase of the current limit) is available in case of heavy torque demands. The limit overcurrent value may be programmed through **par. P060** and **P061** (default value: 100%). If the current required is inconsistent with the max. allowable duty-cycle (150% of the nominal current for 1min every 10min), alarm A022 will trip (*Drive It Trip*).

2.8.3 On the other hand, to achieve a **current limit decrease** through an external command, it is necessary to close one of the ***MDIx*** configurable digital inputs by programming **parameters C130(131)(132)(133)(134)(135)** at value *4:Clim* (said configuration is set by default on *MDI5*, terminal 36), after setting the limit decrease value on **parameter P058** (default value: 50%).

2.8.4 To enable or disable one or more **work quadrants of the torque / speed plan**, set **parameter C160 ... C163** (default values: 1st and 2nd quadrant enabled for DCREG2 (from SW Vers. D4.01), and 1st ... 4th quadrant enabled for DCREG4).

2.9 ANALOG AND DIGITAL OUTPUTS

2.9.1 The **configurable analog outputs** *OUT1* and *OUT2* are available on terminals 8 and 10. Their meaning is indicated by **parameters P150** and **P153** respectively (default value: 0V). Any analog output *OUT1, OUT2* may include ***Gain*** operator (with **parameter P152** and **parameter P155** respectively; default values: 100%), ***Bias*** operator (with **parameter P151** and **parameter P154** respectively; default values: 0%), and ***Polarity*** operator (with **parameter P157** and **parameter P158** respectively; default values: Bipolar).
By moving jumpers JP9 and/or JP10 from pos. 1-2 (standard) to pos. 2-3, said analog outputs turn to 0 ... 20mA current outputs respectively (**outgoing current only**: for the value to be set in the parameters relating to *Gain* and *Bias* operators, see MILLIAMPERE INPUT / OUTPUT SIGNALS chapter).

2.9.2 The two **non-configurable analog outputs** have been already defined: ***n OUT*** on terminal 4 and ***I OUT*** on terminal 6. The latter may be defined as polarity of the output signal through **parameter P156** (default value: Bipolar for DCREG4, and Positive Only for DCREG2).

2.9.3 There are five ***MDOx* configurable digital outputs**. They are available on terminals 25-27, 29-31, 33-35, 37-39 and 41-43, and are defined by **parameters P170(176)(182)(188)(194)**. The *MDOx* configurable digital outputs may include functions ***On Delay*** (with **parameters P171(177)(183)(189)(195)** respectively and default values: 0s), ***Off Delay*** (with **parameters P172(178)(184)(190)(196)** respectively and default values: 0s), ***Level*** (with **parameters P173(179)(185)(191)(197)** respectively and default values: 50%, 3%, 50%, 5%, 50%), ***Hysteresis*** (with **parameters P174(180)(186)(192)(198)** respectively and default values: 2%) and ***Logic*** (with **parameters P175(181)(187)(193)(199)** respectively and default values: Normally Open).

2.10 BACKUP AND RESTORATION OF STORED PARAMETERS

2.10.1 After starting the device and checking its correct settings, it is recommended that the user writes down the parameters that have been changed (and stored) with respect to their default values. To do so, use the special table specified on the last pages of the OPERATION MANUAL, in chapter USER'S PARAMETERS CHANGED WITH RESPECT TO DEFAULT VALUES. If you set **par. P000** to *2:Modified Parms* and if you scroll all other parameters using the arrow keys, the display will show only those parameters having a **current** value **different** than the **default value**.

2.10.2 A **backup of the stored parameters** is recommended. If need be, set **par. P002** to *2:WorkAreaBackup* to enable the **backup parameter restoration**. To do so, set **par. P002** to *3:Backup Restore*.

3 GENERAL CHARACTERISTICS

3.1 GENERAL DESCRIPTION

APPLICATION	The devices of the DCREG series are AC/DC drives with fully digital control system. They fit the armature and field supply of direct current motors to enable the speed or torque control. DCREG4 operates in four quadrants, while DCREG2 operates in two quadrants.
SUPPLY	**Control** section: from 380…500Vac single-phase alternate voltage (or 200…240Vac on request), tolerance +10/-20% taken directly from the power supply three-phase voltage, or differing from it, and not necessarily in phase with it. Alternatively, with a 24Vdc direct voltage, tolerance may be +15/-10% with no hardware adjustment. **Armature** section: from three-phase alternate mains or a 10…440Vac generator unit (by request: 10…500Vac or 10…690Vac). Tolerance is +10% on the maximum applicable voltage, or +20% on rated voltage (C030), should the former tolerance be larger than the latter. Tolerance is -15% over rated voltage with DCREG4, and -20% over rated voltage with DCREG2. Frequency is 50/60Hz. Phase sequence insensitiveness of power phases. **Field** regulator, from 200…500Vac single-phase alternate voltage +10/-20% (For drives assembled till 30th June 2006 only, for a power supply from 200 to 240Vac, jumper J1 is to be enabled on field regulator board ES734 in position "230 ON"). Supply frequency is 50/60 Hz.
AIR-COOLING	Natural with vertical airflow up to DCREG.70, forced ventilation from the DCREG.100 version on. Possibility of THROUGH PANEL assembly for all sizes.
OVERLOAD CAPACITY	Current limit increasing capacity up to 150% of the nominal value. The max. overload cycle determining the alarm protection trip consists of a 150% current overlimit lasting for 1 minute. It can be performed with a 1:10 duty-cycle.
CONTROL	Fully digital with feedback double loop, inner adjustment for the current control and external adjustment for the voltage / speed control. Equipped with two micro controllers: one of them is specially designed to perform the current loop and offers the possibility of choosing between a PI-type regulator or - in case of a DCREG4 type only - a predictive algorithm to achieve a more dynamic response. Adaptive speed regulator and automatically variable parameters according to the speed error. Two sets of regulation parameters available for the speed loop, referring to two possible different situations of the motor (i.e. the mechanical time constant, the reduction ratio, the inertial moment, etc.).
SPEED REACTION	From tacho, encoder, or armature feedback. Possibility of automatically switching to the armature feedback in case of failures.

OPERATING FEATURES	DCREG4: operation and total reversibility in the four quadrants: may operate as a motor or a brake towards both directions of rotation. Speed or torque control system. DCREG2: operation as motor in the 1st quadrant with speed or torque control system. May operate as a brake in the 2nd quadrant with speed or torque control system. In both drive versions, each quadrant may be enabled or disabled independently. Possibility of operation with constant available maximum torque / power through an internal field regulator.
AUTOMATIC TUNING	The drive acknowledges the main characteristics of the motor and load to automatically calculate the most convenient parameters to be introduced in the speed and current loops.
SERIAL INTERFACE	It may be supplied with a MODBUS protocol according to RS232-C standard and RS485 standard. For more details, please contact Elettronica Santerno and ask for PC-DCREG INTERFACING VIA MODBUS (code 16B0301B3).
FIELDBUS	ProfiBus-DP available. By request, InterBus, DeviceNet, ControlNet, CANopen are available. The following items may be set at DCREG input: a) START and ENABLE digital inputs and six programmable digital inputs. b) Speed / voltage reference or current reference. Finally, DCREG may duplicate - by means of its programmable analog or digital outputs - the input signals sent by the field bus, and resend those signals to the bus field for the analog or digital inputs. For more information, please ask for PC-DCREG INTERFACING VIA PROFIBUS-DP (code 16B0221B3).
ACCURACY	± 0.1% of rated speed following: 1) Load variations up to 100% of the rated torque. 2) Root mean square variations of the supply voltage of +10/-15% (or higher, depending on each case) with respect to the rated value. 3) Temperature variations of ±10°C.
ANALOG INPUTS	No. 3 configurable analog inputs and No. 1 fixed analog input, 12-bit resolution + sign. No. 2 voltage analog inputs ±10Vdc (input resistance 20kΩ) or current analog inputs 4÷20mA (load resistance 200Ω) are available with differential input or common-mode (in both cases). Possibility of application of *Bias, Gain, Polarity, Reverse* operators. Minimum speed function available by request.
INTERNAL REFERENCES	Seven preset run references and 2 jog references are provided. One run reference is also available, that can be used for the Motorized Potentiometer function.
RAMP FUNCTION	Fully digital function with independent setting (may also be external) of acceleration or deceleration time duration for both running directions. Outside zero setting command for ramp times. Possibility of initial or final ramp rounding with 2nd type function. In the DCREG4, automatic extension of the acceleration or deceleration ramps whenever the load requires a torque value very close to the maximum torque (in both cases, either motor or braking respectively). In DCREG2, automatic extension of the deceleration ramp whenever inferior to the coasting time. In that way the ramp generated inside the drive is always related to the motor actual speed.

ANALOG OUTPUTS	No. 2 configurable analog outputs, 12-bit resolution. Possibility of application of *Bias, Gain, Polarity* operators. *V Out* voltage signal proportional to the motor running speed. *I Out* current signal proportional to the supplied armature current (double polarity or positive single polarity only).
DIGITAL INPUTS	No. 6 configurable digital inputs for different functions and No. 2 fixed digital inputs for the *START* and *ENABLE* commands. All inputs are optoinsulated and PLC-controllable with PNP static outputs.
DIGITAL OUTPUTS	5 configurable relay digital outputs. On the digital outputs the following functions may be programmed: energizing delay, de-energizing delay, positive or negative logic, hysteresis.
LOCAL MODE OPERATION	For the LOCAL mode operation, the drive may be equipped with a keypad (by request) with a backlit alphanumeric display, 8 keys and 8 LEDs. The jog, running / stop and reference reversal commands may also be entered through the keypad, in addition to the LOCAL mode switching to the ordinary operating mode stored on EEPROM. The keypad may be removed or remote controlled. Once the drive has been set, it may be operated also with no keypad connection. Both 7-segment displays can be seen through a special slot fitted on the cover of the ES800 (ES906) control board (together with the four LEDs) for the most important indications.
DRIVE ADJUSTMENTS	The ES800 (ES906) control board is equipped with an EEPROM (non volatile memory) where all the special parameters of the drive together with the machine adjustments are stored after automatic tuning procedures or according to the user's requirements. The EEPROM is an 8-pin component fitted on a socket which can be very easily removed and then fitted on an additional board in case of possible failures, with no need to repeat the machine running procedure. Possibility of restoring the default parameters or any parameters relating to a special configuration including prior back-up. Possibility of displaying only the parameters having a current value different from the default value. Firmware updating via serial source downloading (using FLASH memory). For more information, please ask for the DCREG FIRMWARE UPDATING VIA SERIAL COMMUNICATION manual (code 16B0211A1).
PROTECTIONS	From output short-circuit: ultra-fast fuses to be fitted externally by the Customer for DCREG Size 1 … 2A. Already fitted inside in DCREG MODULAR.S. From excessive $\frac{dV}{dt}$ on thyristors: R-C single filters together with the varistors on the three-phase line. From lack of drive ventilation: alarm A002 from thermo switch on heatsink. From drive overload: alarm A022 from Ixt thermal image of the same. From motor overload: alarm A021 from I^2t thermal image of the same. From armature overcurrent: alarm A003. From field overcurrent: alarm A009. From field regulator failure: alarm A001, A023. From armature overvoltage: alarm A010. From load loss: alarm A004. From unstable or out of range mains frequency: alarms A006 and A012. From mains supply three-phase failure: alarms A007, A013, A016 and A017, with possibility of disabling any alarm related to mains microlosses.

From speed feedback failure: alarm A008.
From automatic tuning failure: alarms A011, A014, A015, A018 and A019.
From general external failure: alarm A020, A029 and A030.
From EEPROM failure: alarms A024, A025, A026 and A031.
From serial communication failure: alarm A027.
From bus field connection failure: alarm A028.

STANDARDS

DCREG drives comply with "Low-Voltage Directive" and "Electromagnetic Compatibility Directive". As for the "Machine Directive", the drives are considered as a component part, not a whole machine. In accordance with this directive, Elettronica Santerno releases the Manufacturer's Statement for DCREG2 and DCREG4.
Said drives particularly comply with the standards below.

Low-voltage DIRECTIVE (73/23/CEE and following amendment 93/68/CEE):

EN60146-1-1/IEC146-1-1: Semiconductor converters. General requirements and line-commutated converters. Part 1-1: Specifications of basic requirements.

EN61800-2/IEC1800-2: Adjustable speed electrical power drive systems. Part 1: Rating specifications for low voltage d.c. power drive systems.

EN50178: Electronic equipment for use in power installations. → pollution degree: 2

EN60529/IEC529: Degrees of protection provided by enclosures (IP code). → degree of protection: IP00

EN60204-1/IEC204-1: Safety of machinery. Electrical equipment of machines. Part 1: General requirements.

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE (89/336/CEE and following amendments 92/31/CEE, 93/68/CEE and 93/97/CEE):

- IMMUNITY:
EN61000-4-2/IEC1000-4-2: Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity tests. EMC Basic Publication. → level 3: 6kV for contact discharge, 8kV for air discharge.

EN61000-4-3/IEC1000-4-3: Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test. → level 3: field intensity: 10V/m

EN61000-4-4/IEC1000-4-4: Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test. EMC Basic Publication. → level 3: 2kV/5kHz for power-supply ports, 1kV/5kHz for signal interfaces, 2kV/5kHz for measurement and control ports.

EN61000-4-5/IEC1000-4-5: Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 5: Surge immunity test. → level 3: 1kV for line/line connection and 2kV for line/ground connection.

- RADIOFREQUENCY RADIATED DISTURBANCE:
EN61800-3/IEC1800-3, second environment (industrial grid) → with no RFI filter
EN61800-3, first environment (civic grid), EN55011 group 1, class A and B, EN55022 class A and B → using optional RFI filters
For the definition of "first environment" and "second environment" and for the instructions on how to choose the filters to be used, see chapter EMC CHARACTERISTICS AND INPUT FILTERS.

WORKING TEMPERATURES

From 0 to 40°C ambient temperature. 2% derating for each degree of temperature increase.

MAXIMUM OPERATING ALTITUDE

1000m (a.s.l.). 1% derating for each 100m of altitude increase.

RELATIVE HUMIDITY

20 … 90% (non-condensing).

WEIGHT

Size 1:
13 kg for DCREG.10 … 40
14 kg for DCREG.70
15 kg for DCREG.100 … 180
18 kg for DCREG2.250 … 350
19 kg for DCREG4. 250 … 350

Size 2:
45 kg for DCREG2 except for:
38 kg for DCREG2.410 ... 600 @ 600Vmax

48 kg for DCREG4 except for:
40 kg for DCREG4.410 ... 600 @ 600Vmax

Size 2A:
51 kg for DCREG2. Size 2A
54 kg for DCREG4. Size 2A

MODULAR.S (Total weight of control unit + power unit)
79 kg for DCREG2.1600-1800-2000S (*Size A*)
124 kg for DCREG2.2300-2500(@500V, 600V)S (*Size B*)
164 kg for DCREG2.2500(@690V)-2700-3000S (*Size C*)
206 kg for DCREG2.3500S (*Size D*)
319 kg for DCREG2.4500S (*Size E*)
84 kg for DCREG4.1050-1250-1400S (*Size F*)
159 kg for DCREG4.1600-1800-2000S (*Size G*)
229 kg for DCREG4.2300-2500(@500V, 600V)S (*Size H*)
289 kg for DCREG4.2500(@690V)-2700-3000S (*Size I*)
331 kg for DCREG4.3500S (*Size J*)
624 kg for DCREG4.4500S (*Size K*)
57 kg for DCREG2.1050S (*Size L*)

3.2 RATINGS

DCREG2(4) Size 1 ... 2A
Power supply 440Vac max. for ARMATURE circuit. Power supply 200 ... 500Vac for FIELD circuit (see Note 1)

SIZE	DIMENSIONS LxDxH (mm)	MODEL	ARMATURE OUTPUT VOLTAGE (Vdc)	ARMATURE RATED DI CURRENT (A)	FIELD OUTPUT VOLTAGE (Vdc)	FIELD RATED CURRENT (A)	AC-SIDE ULTRAFAST FUSES (FU1-2-3)	DC-SIDE ULTRAFAST FUSES (FU4)	DISSIPATED POWER (W)
1	214x264x440	**DCREG2.10 DCREG4.10**	DCREG2: 530 max (440 Vin) DCREG4: 460 max (440 Vin)	10	425 max (500 Vin)	5	35÷40A 00T/80	35÷40A 00T/80	30
		DCREG2.20 DCREG4.20		20			35÷40A 00T/80	35÷40A 00T/80	60
		DCREG2.40 DCREG4.40		40			35÷40A 00T/80	50A 00T/80	120
		DCREG2.70 DCREG4.70		70			80A 00T/80	100A 00T/80	210
		DCREG2.100 DCREG4.100		100			100A 00T/80	125A 00T/80	300
		DCREG2.150 DCREG4.150		150		15	160A 00T/80	200A 00T/80	450
		DCREG2.180 DCREG4.180		180			160A 00T/80	250A 00T/80	540
		DCREG2.250 DCREG4.250		250			250A 00T/80	315A 00T/80	750
		DCREG2.350 DCREG4.350		350			315A 00T/80	375÷400 A 00T/80	1050
2	333x360x596	**DCREG2.410 DCREG4.410**		410		35	450A 2T/80	550A 2T/80	1230
		DCREG2.500 DCREG4.500		500			550A 2T/80	700A 3T/80	1500
		DCREG2.600 DCREG4.600		600			630A 2T/80	800A 3T/80	1800
		DCREG2.900 DCREG4.900		900			900A 3T/80	1250A 3T/80	2700
2A	333x453x685	**DCREG2.1200 DCREG4.1200**		1200			1100A 3T/80	1400A 3T/80	3600

NOTE By request, Elettronica Santerno can provide drives of any size with **a field rated current different than the standard value**, which is 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2, 2A and MODULAR.S

(1) For drives assembled till 30th June 2006 only, in order to supply terminals E1-2 with a voltage ranging from 200 to 240Vac, enable jumper J1 on field regulator ES734 in position "*230 ON*". In that case, the max. field output voltage is 205Vdc (240 Vin).

DCREG2(4) Size 1 ... 2A / DCREG2(4) MODULAR.S

Power supply 500 Vac max. for ARMATURE circuit. Power supply 200 ... 500Vac for FIELD circuit (see Note 1)

SIZE	DIMENSIONS LxDxH (mm) (For Modular types, measures refer to POWER UNIT)	MODEL	ARMATURE OUTPUT VOLTAGE (Vdc)	ARMATURE RATED DI CURRENT (A)	FIELD OUTPUT VOLTAGE (Vdc)	FIELD RATED CURRENT (A)	AC-SIDE ULTRAFAST FUSES (FU1-2-3)	DC-SIDE ULTRAFAST FUSES (FU4)	DISSIPATED POWER (W)
1	214x264x440	**DCREG2.10** **DCREG4.10**	DCREG2: 600 max (500 Vin) DCREG4: 520 max (500 Vin)	10	425 max (500 Vin)	5	35÷40A 00T/80	35÷40A 00T/80	30
		DCREG2.20 **DCREG4.20**		20			35÷40A 00T/80	35÷40A 00T/80	60
		DCREG2.40 **DCREG4.40**		40			35÷40A 00T/80	50A 00T/80	120
		DCREG2.70 **DCREG4.70**		70			80A 00T/80	100A 00T/80	210
		DCREG2.100 **DCREG4.100**		100			100A 00T/80	125A 00T/80	300
		DCREG2.150 **DCREG4.150**		150		15	160A 00T/80	200A 00T/80	450
		DCREG2.180 **DCREG4.180**		180			160A 00T/80	250A 00T/80	540
		DCREG2.250 **DCREG4.250**		250			250A 00T/80	315A 00T/80	750
		DCREG2.350 **DCREG4.350**		350			315A 00T/80	375÷400 A 00T/80	1050
2	333x360x596	**DCREG2.410** **DCREG4.410**		410		35	450A 2T/80	550A 2T/80	1230
		DCREG2.500 **DCREG4.500**		500			550A 2T/80	700A 3T/80	1500
		DCREG2.600 **DCREG4.600**		600			630A 2T/80	800A 3T/80	1800
		DCREG2.900 **DCREG4.900**		900			900A 3T/80	1250A 3T/80	2700
2A	333x453x685	**DCREG2.1200** **DCREG4.1200**		1200			1100A 3T/80	1400A 3T/80	3600
MODULAR.S	500x275x860 (Size F)	**DCREG4.1400S**	DCREG2: 600 max (500 Vin) DCREG4: 520 max (500 Vin)	1400	425 max (500 Vin)	35	-	-	4200
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.1600S** **DCREG4.1600S**		1600					4800
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.1800S** **DCREG4.1800S**		1800					5400
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.2000S** **DCREG4.2000S**		2000					6000
	620x360x884 (Size B) 620x495x1434 (Size H)	**DCREG2.2300S** **DCREG4.2300S**		2300					6900
	620x360x884 (Size B) 620x495x1434 (Size H)	**DCREG2.2500S** **DCREG4.2500S**		2500					7500
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.2700S** **DCREG4.2700S**		2700					8100
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.3000S** **DCREG4.3000S**		3000					9000
	784x415x1110 (Size D) 784x460x1790 (Size J)	**DCREG2.3500S** **DCREG4.3500S**		3500					10500
	968x482x1250 (Size E) 988x543x2070 (Size K)	**DCREG2.4500S** **DCREG4.4500S**		4500					13500

NOTE By request, Elettronica Santerno can provide drives of any size with **a field rated current different than the standard value**, which is 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2, 2A and MODULAR.S

(1) For drives assembled till 30th June 2006 only, in order to supply terminals E1-2 with a voltage ranging from 200 to 240Vac, enable jumper J1 on field regulator ES734 in position "*230 ON*". In that case, the max. field output voltage is 205Vdc (240 Vin).

DCREG2(4) Size 1 ... 2A / DCREG2(4) MODULAR.S

Power supply 600Vac max. for ARMATURE circuit. Power supply 200 ... 500Vac for FIELD circuit (see Note 1)

SIZE	DIMENSIONS LxDxH (mm) (For Modular types, measures refer to POWER UNIT)	MODEL	ARMATURE OUTPUT VOLTAGE (Vdc)	ARMATURE RATED DI CURRENT (A)	FIELD OUTPUT VOLTAGE (Vdc)	FIELD RATED CURRENT (A)	AC-SIDE ULTRAFAST FUSES (FU1-2-3)	DC-SIDE ULTRAFAST FUSES (FU4)	DISSIPATED POWER (W)
1	214x264x440	**DCREG2.10** **DCREG4.10**	DCREG2: 720 max (600 Vin) DCREG4: 630 max (600 Vin)	10	425 max (500 Vin)	5	35÷40A 00T/80	35÷40A 00T/80	30
		DCREG2.20 **DCREG4.20**		20			35÷40A 00T/80	35÷40A 00T/80	60
		DCREG2.40 **DCREG4.40**		40			35÷40A 00T/80	50A 00T/80	120
		DCREG2.70 **DCREG4.70**		70			80A 00T/80	100A 00T/80	210
		DCREG2.100 **DCREG4.100**		100			100A 00T/80	125A 00T/80	300
		DCREG2.150 **DCREG4.150**		150		15	160A 00T/80	200A 00T/80	450
		DCREG2.180 **DCREG4.180**		180			160A 00T/80	250A 00T/80	540
		DCREG2.250 **DCREG4.250**		250			250A 00T/80	315A 00T/80	750
		DCREG2.350 **DCREG4.350**		350			315A 00T/80	375÷400 A 00T/80	1050
2	333x360x596	**DCREG2.410** **DCREG4.410**		410		35	450A 2T/80	550A 2T/80	1230
		DCREG2.500 **DCREG4.500**		500			550A 2T/80	700A 3T/80	1500
		DCREG2.600 **DCREG4.600**		600			630A 2T/80	800A 3T/80	1800
		DCREG2.750 **DCREG4.750**		750			800A 3T/80	1000A 3T/80	2250
2A	333x453x685	**DCREG2.900** **DCREG4.900**		900			900A 3T/80	1250A 3T/80	2700
MODULAR.S	500x275x665 (Size L)	**DCREG2.1050S**	DCREG2: 720 max (600 Vin) DCREG4: 630 max (600 Vin)	1050	425 max (500 Vin)	35	-	-	3150
	500x275x860 (Size F)	**DCREG4.1250S**		1250					3750
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.1600S** **DCREG4.1600S**		1600					4800
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.1800S** **DCREG4.1800S**		1800					5400
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.2000S** **DCREG4.2000S**		2000					6000
	620x360x884 (Size B) 620x495x1434 (Size H)	**DCREG2.2300S** **DCREG4.2300S**		2300					6900
	620x360x884 (Size B) 620x495x1434 (Size H)	**DCREG2.2500S** **DCREG4.2500S**		2500					7500
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.2700S** **DCREG4.2700S**		2700					8100
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.3000S** **DCREG4.3000S**		3000					9000
	784x415x1110 (Size D) 784x460x1790 (Size J)	**DCREG2.3500S** **DCREG4.3500S**		3500					10500
	968x482x1250 (Size E) 988x543x2070 (Size K)	**DCREG2.4500S** **DCREG4.4500S**		4500					13500

NOTE By request, Elettronica Santerno can provide drives of any size with **a field rated current different than the standard value**, which is 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2, 2A and MODULAR.S

(1) For drives assembled till 30th June 2006 only, in order to supply terminals E1-2 with a voltage ranging from 200 to 240Vac, enable jumper J1 on field regulator ES734 in position "*230 ON*". In that case, the max. field output voltage is 205Vdc (240 Vin).

DCREG2(4) Size 1 ... 2A / DCREG2(4) MODULAR.S

Power supply 690Vac max. for ARMATURE circuit. Power supply 200 ... 500Vac for FIELD circuit (see Note 1)

SIZE	DIMENSIONS LxDxH (mm) (For Modular types, measures refer to POWER UNIT)	MODEL	ARMATURE OUTPUT VOLTAGE (Vdc)	ARMATURE RATED DI CURRENT (A)	FIELD OUTPUT VOLTAGE (Vdc)	FIELD RATED CURRENT (A)	AC-SIDE ULTRAFAST FUSES (FU1-2-3)	DC-SIDE ULTRAFAST FUSES (FU4)	DISSIPATED POWER (W)
1	214x264x440	**DCREG2.10 DCREG4.10**	DCREG2: 800 max (690 Vin) DCREG4: 720 max (690 Vin)	10	425 max (500 Vin)	5	35÷40A 00T/80	35÷40A 00T/80	30
		DCREG2.20 DCREG4.20		20			35÷40A 00T/80	35÷40A 00T/80	60
		DCREG2.40 DCREG4.40		40			35÷40A 00T/80	50A 00T/80	120
		DCREG2.70 DCREG4.70		70			80A 00T/80	100A 00T/80	210
		DCREG2.100 DCREG4.100		100			100A 00T/80	125A 00T/80	300
		DCREG2.150 DCREG4.150		150		15	160A 00T/80	200A 00T/80	450
		DCREG2.180 DCREG4.180		180			160A 00T/80	250A 00T/80	540
		DCREG2.250 DCREG4.250		250			250A 00T/80	315A 00T/80	750
		DCREG2.350 DCREG4.350		350			315A 00T/80	375÷400 A 00T/80	1050
2	333x360x596	**DCREG2.410 DCREG4.410**		410		35	450A 2T/80	550A 2T/80	1230
		DCREG2.500 DCREG4.500		500			550A 2T/80	700A 3T/80	1500
		DCREG2.600 DCREG4.600		600			630A 2T/80	800A 3T/80	1800
		DCREG2.750 DCREG4.750		750			800A 3T/80	1000A 3T/80	2250
2A	333x453x685	**DCREG2.900 DCREG4.900**		900			900A 3T/80	1250A 3T/80	2700

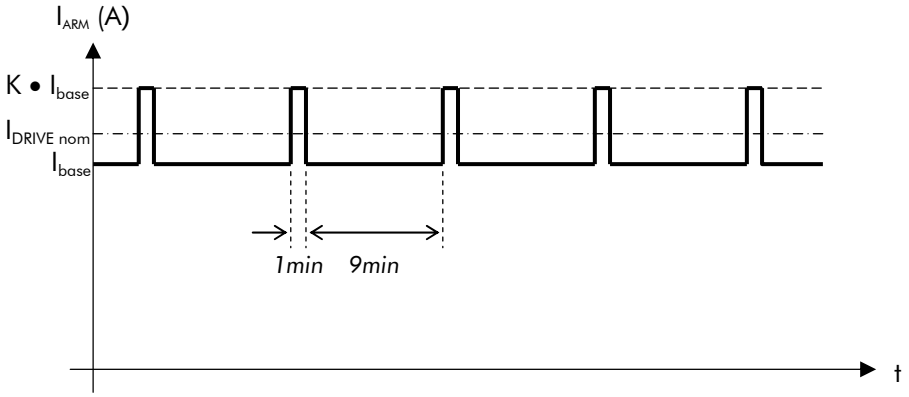
MODULAR.S	500x275x665 (Size L) 500x275x860 (Size F)	**DCREG2.1050S DCREG4.1050S**	DCREG2: 800 max (690 Vin) DCREG4: 720 max (690 Vin)	1400	425 max (500 Vin)	35	-	-	3150
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.1600S DCREG4.1600S**		1600					4800
	500x275x860 (Size A) 500x375x1410 (Size G)	**DCREG2.2000S DCREG4.2000S**		2000					6000
	620x360x884 (Size B) 620x495x1434 (Size H)	**DCREG2.2300S DCREG4.2300S**		2300					6900
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.2500S DCREG4.2500S**		2500					7500
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.2700S DCREG4.2700S**		2700					8100
	712x395x945 (Size C) 712x495x1505 (Size I)	**DCREG2.3000S DCREG4.3000S**		3000					9000
	784x415x1110 (Size D) 784x460x1790 (Size J)	**DCREG2.3500S DCREG4.3500S**		3500					10500
	968x482x1250 (Size E) 988x543x2070 (Size K)	**DCREG2.4500S DCREG4.4500S**		4500					13500

NOTE NOTE: By request, Elettronica Santerno can provide drives of any size with **a field rated current different than the standard value**, which is 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2, 2A and MODULAR.S

(1) For drives assembled till 30th June 2006 only, in order to supply terminals E1-2 with a voltage ranging from 200 to 240Vac, enable jumper J1 on field regulator ES734 in position "*230 ON*". In that case, the max. field output voltage is 205Vdc (240 Vin).

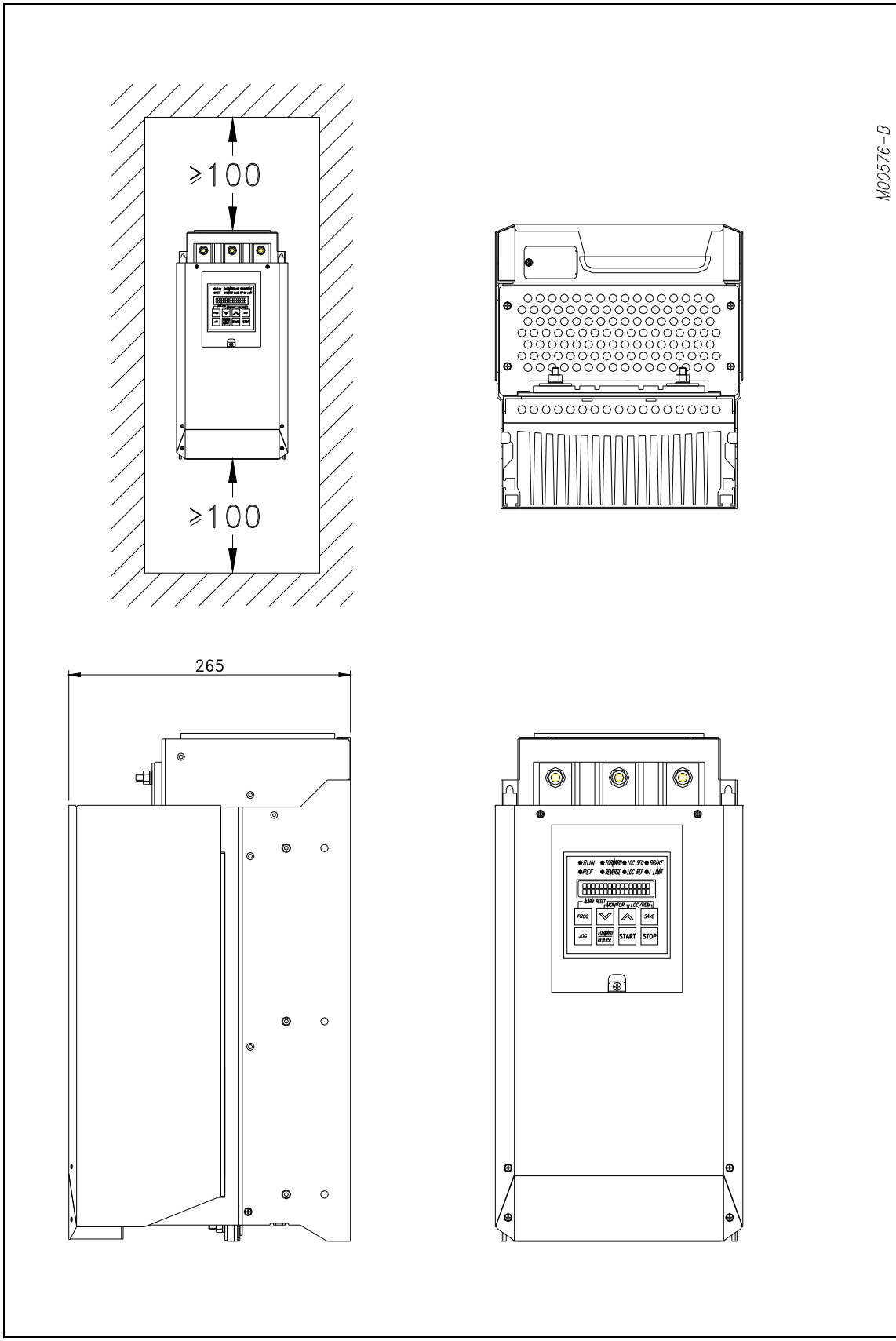
OVERLOAD CAPACITY

Repetitive overload cycle, I = k • I(base) for 1m and I = I(base) for 9m @ T = 40°C (room temperature), available after an operation at a current not larger than the rated value I DRIVEnom (par. C000) for a period sufficient for temperature stabilization.

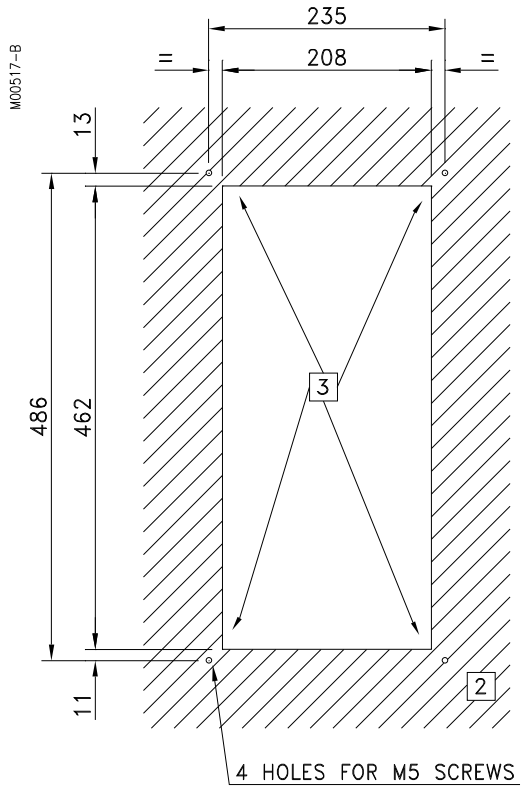


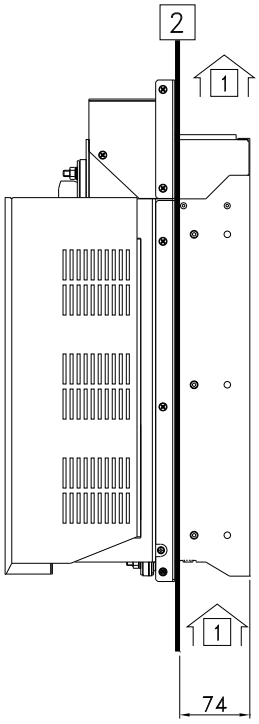
SIZE	MODEL	K (par. P060, P061) OVERLOAD PERCENTAGE	I(base) BASE CURRENT FOR SPECIFIED OVERLOAD (A)
Gr.1	DCREG2(4).10	150%	10
	DCREG2(4).20		20
	DCREG2(4).40		40
	DCREG2(4).70		70
	DCREG2(4).100		100
	DCREG2(4).150		150
	DCREG2(4).180		180
	DCREG2(4).250		250
	DCREG2(4).350		350
Gr.2	DCREG2(4).410		410
	DCREG2(4).500		500
	DCREG2(4).600		600
	DCREG2(4).750		750
	DCREG2(4).900		900
Gr.2A	DCREG2(4).900		900
	DCREG2(4).1200		1200
MODULAR.S	DCREG2(4).1050	125%	1000
	DCREG4.1250		1100
	DCREG4.1400		1200
	DCREG2(4).1600		1400
	DCREG2(4).1800		1640
	DCREG2(4).2000		1750
	DCREG2(4).2300		2000
	DCREG2(4).2500		2200
	DCREG2(4).2700		2480
	DCREG2(4).3000		2500
	DCREG2(4).3500		3000
	DCREG2(4).4500		3700

3.3 DCREG SIZE 1 OVERALL DIMENSIONS

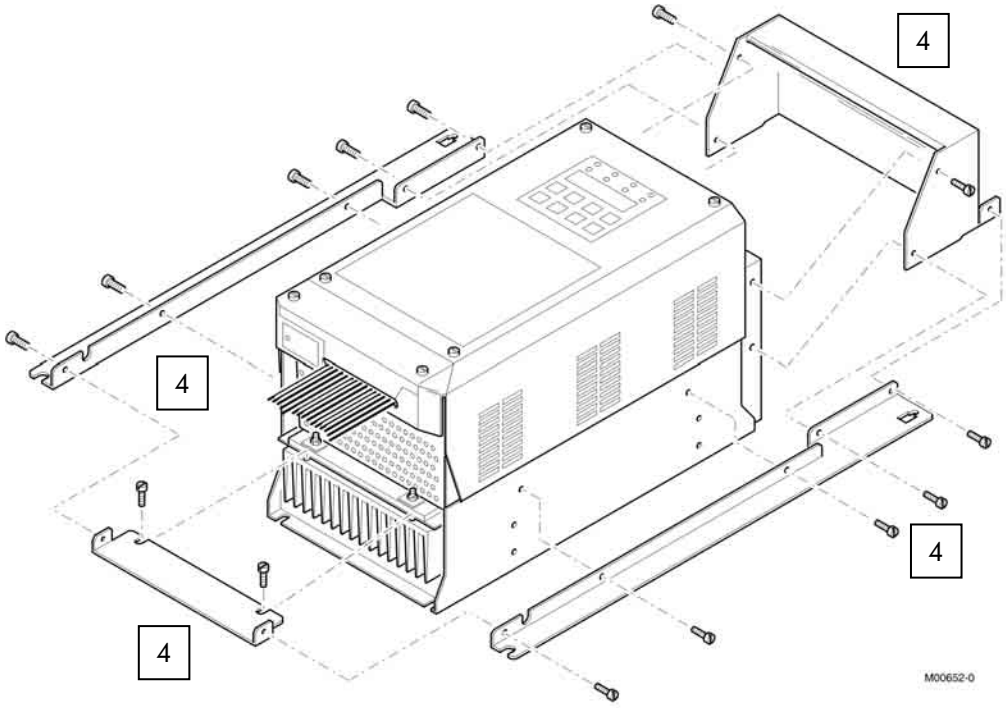


3.4 DCREG SIZE 1 THROUGH-PANEL ASSEMBLY

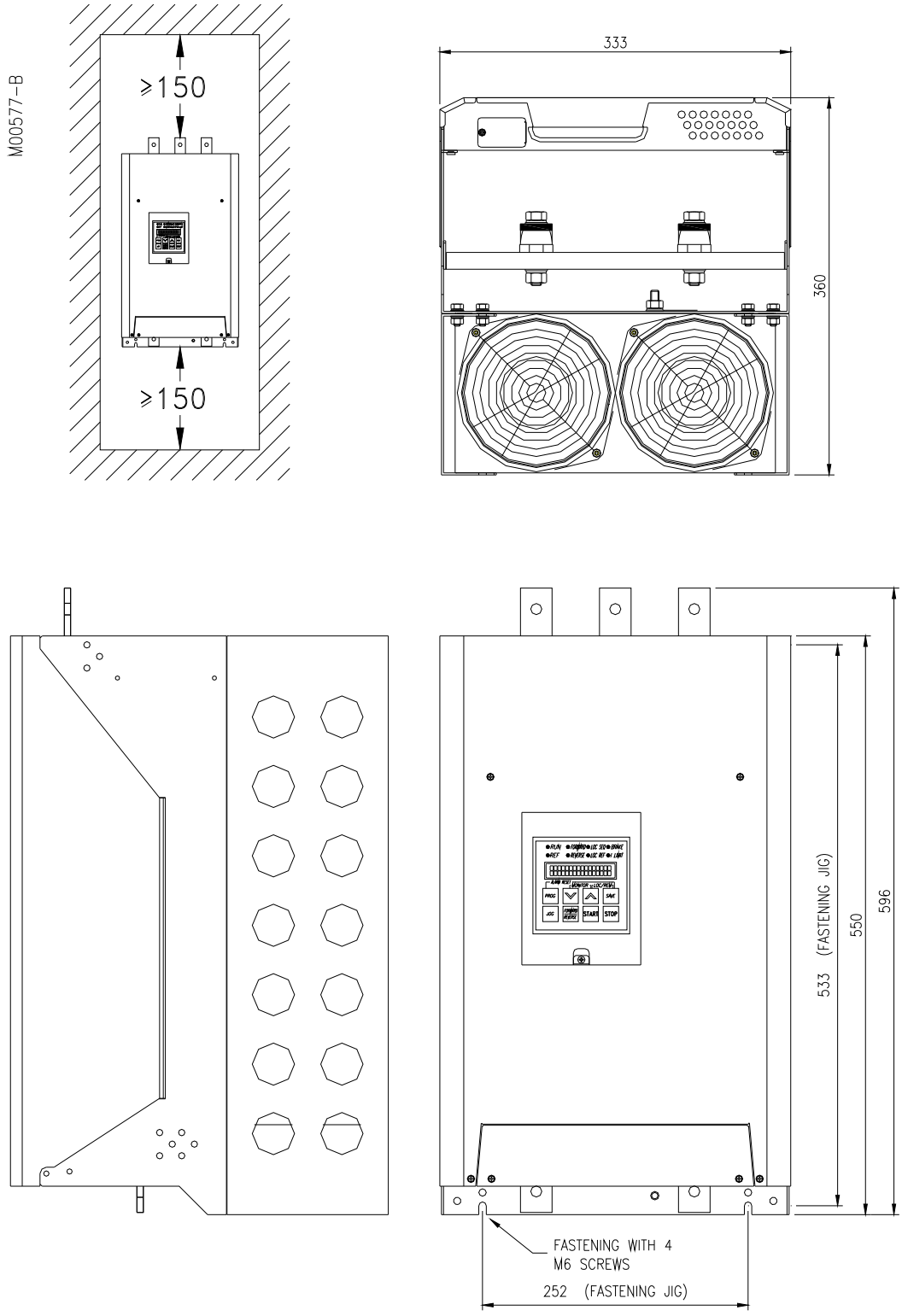




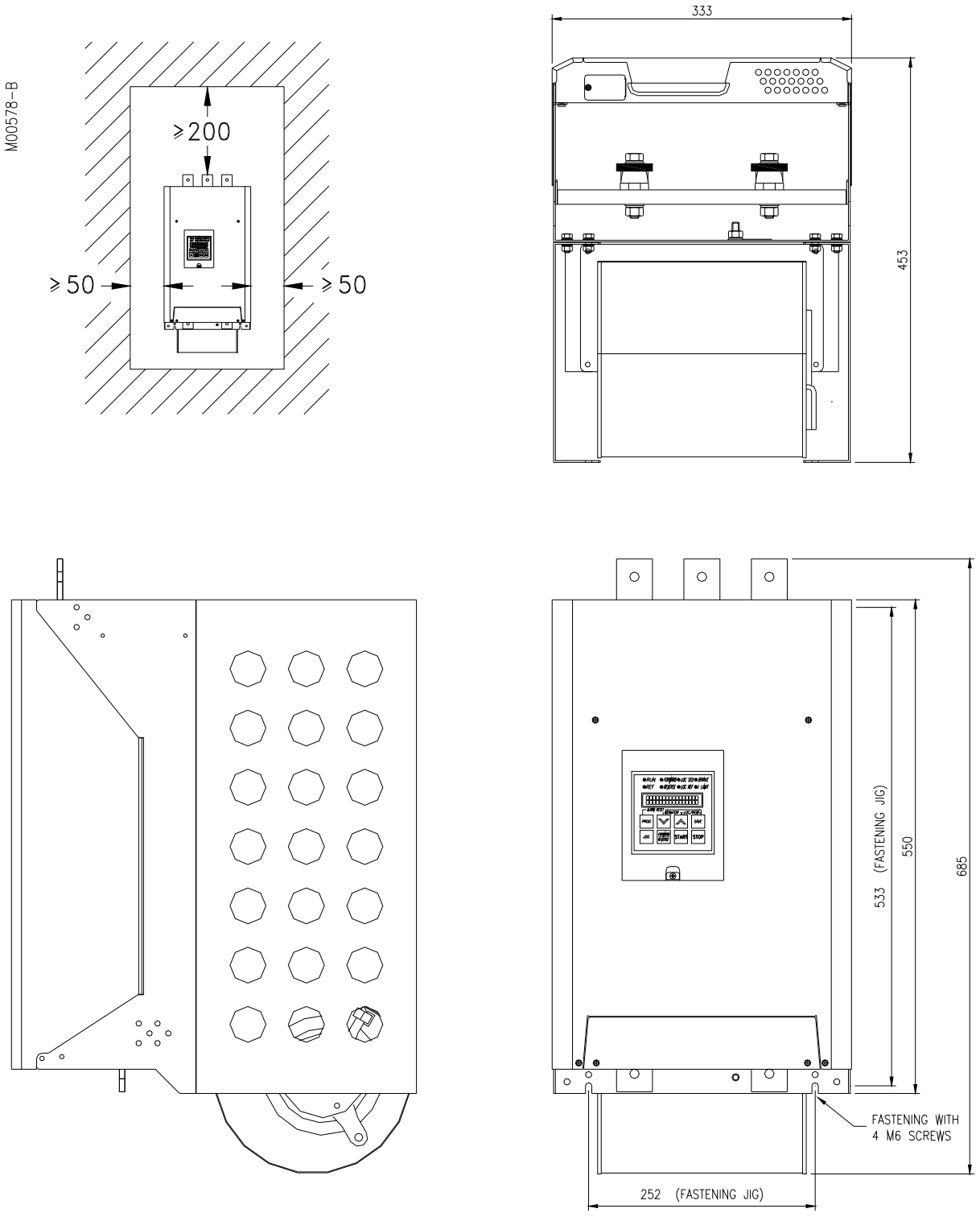
1 - Direction of the cooling air flow
2 - Fixing panel
3 - Slot to be made in the fixing panel
4 - Through-panel assembly kit parts



3.5 DCREG SIZE 2 OVERALL DIMENSIONS

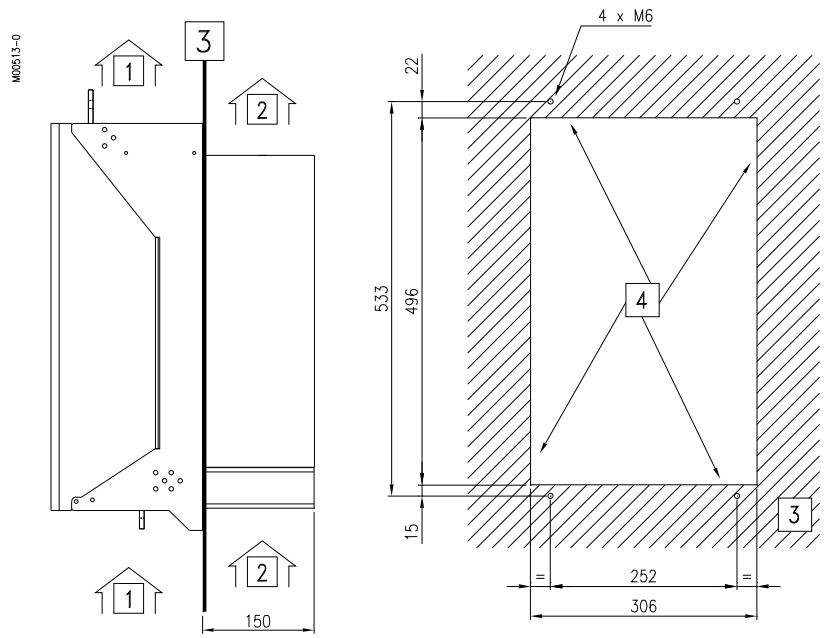


3.6 DCREG SIZE 2A OVERALL DIMENSIONS



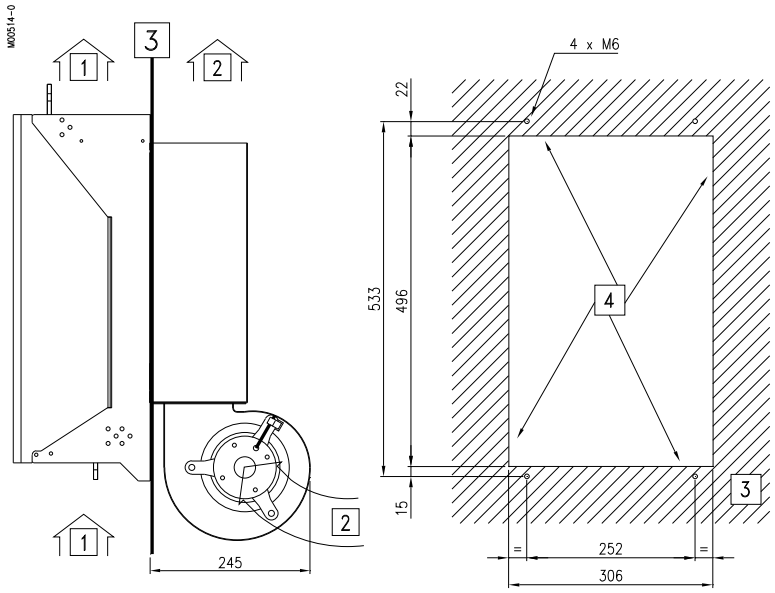
3.7 DCREG SIZE 2 AND SIZE 2A THROUGH-PANEL ASSEMBLY

- Size 2

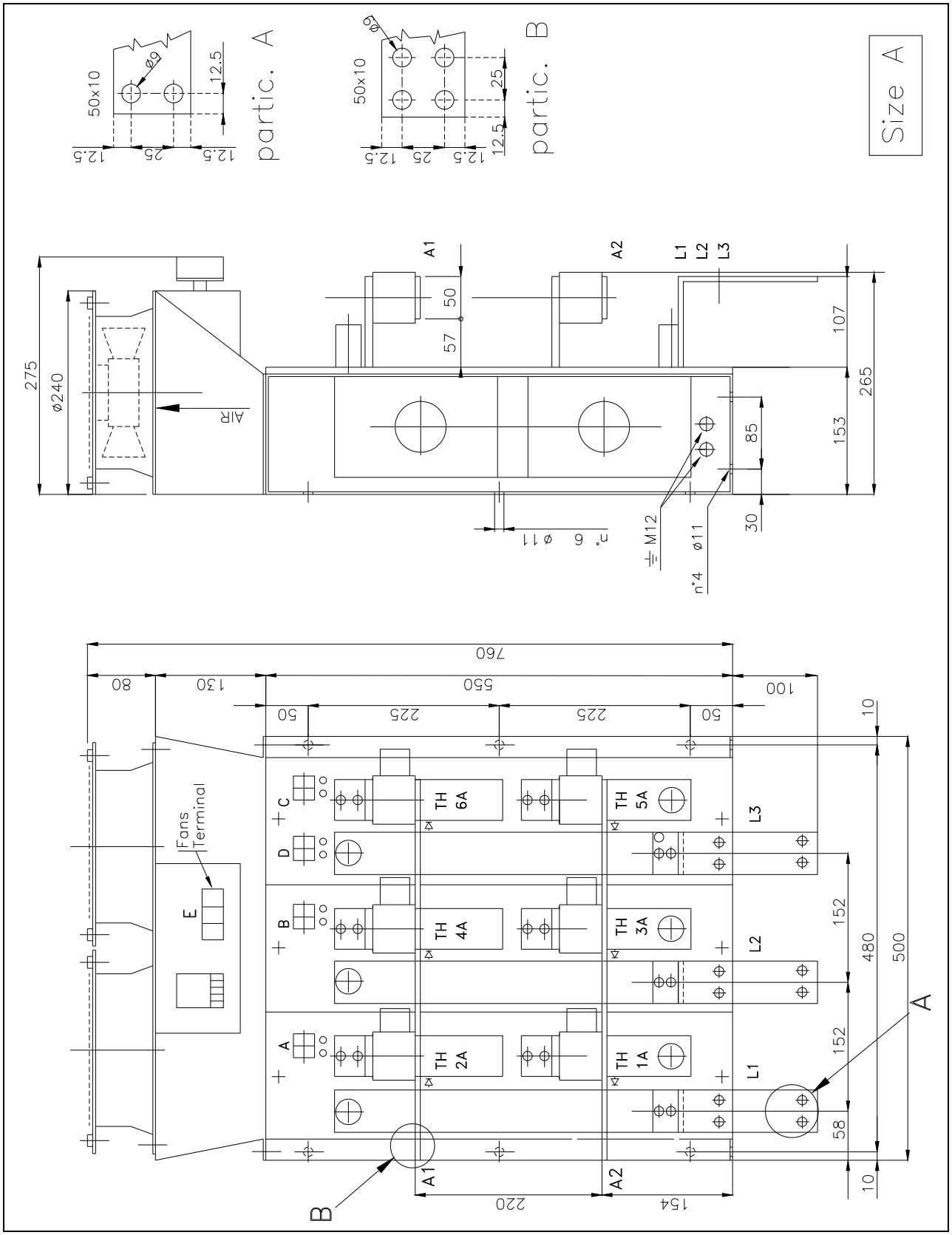


1 - Direction of the secondary cooling air flow
2 - Direction of the main cooling air flow
3 - Fixing panel
4 - Slot to be made in the fixing panel

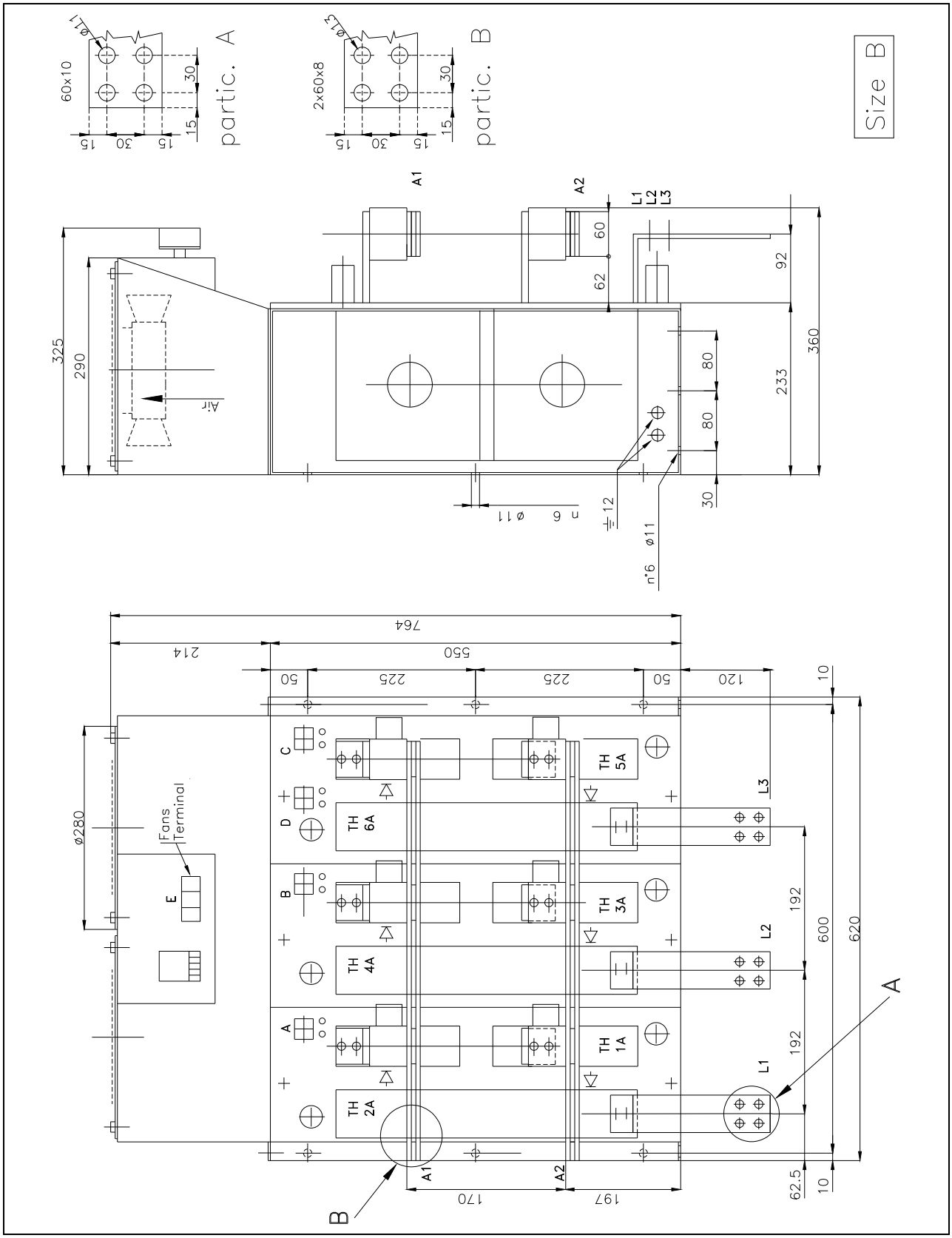
- Size 2A



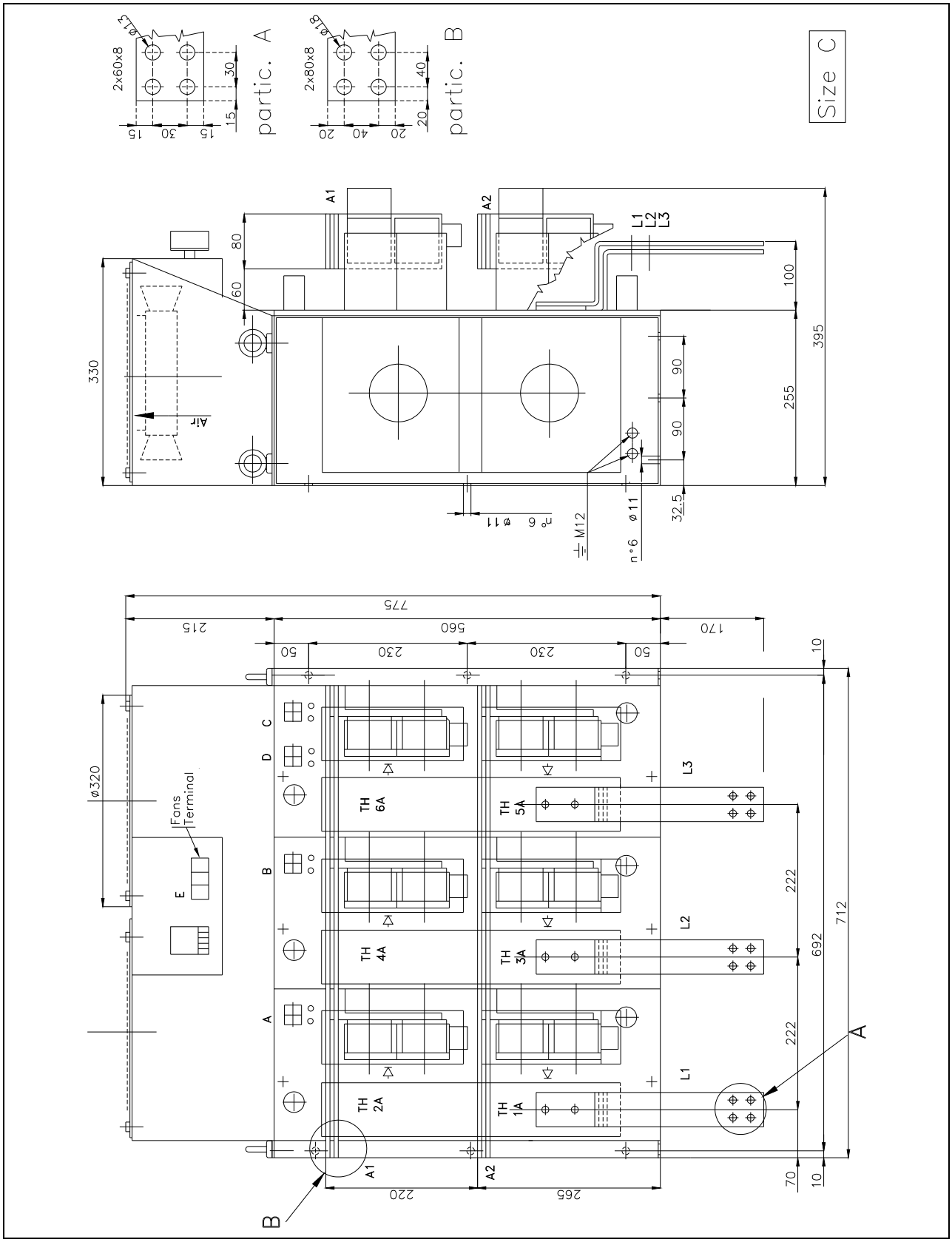
3.8 DCREG MODULAR.S SIZE A POWER SECTION OVERALL DIMENSIONS



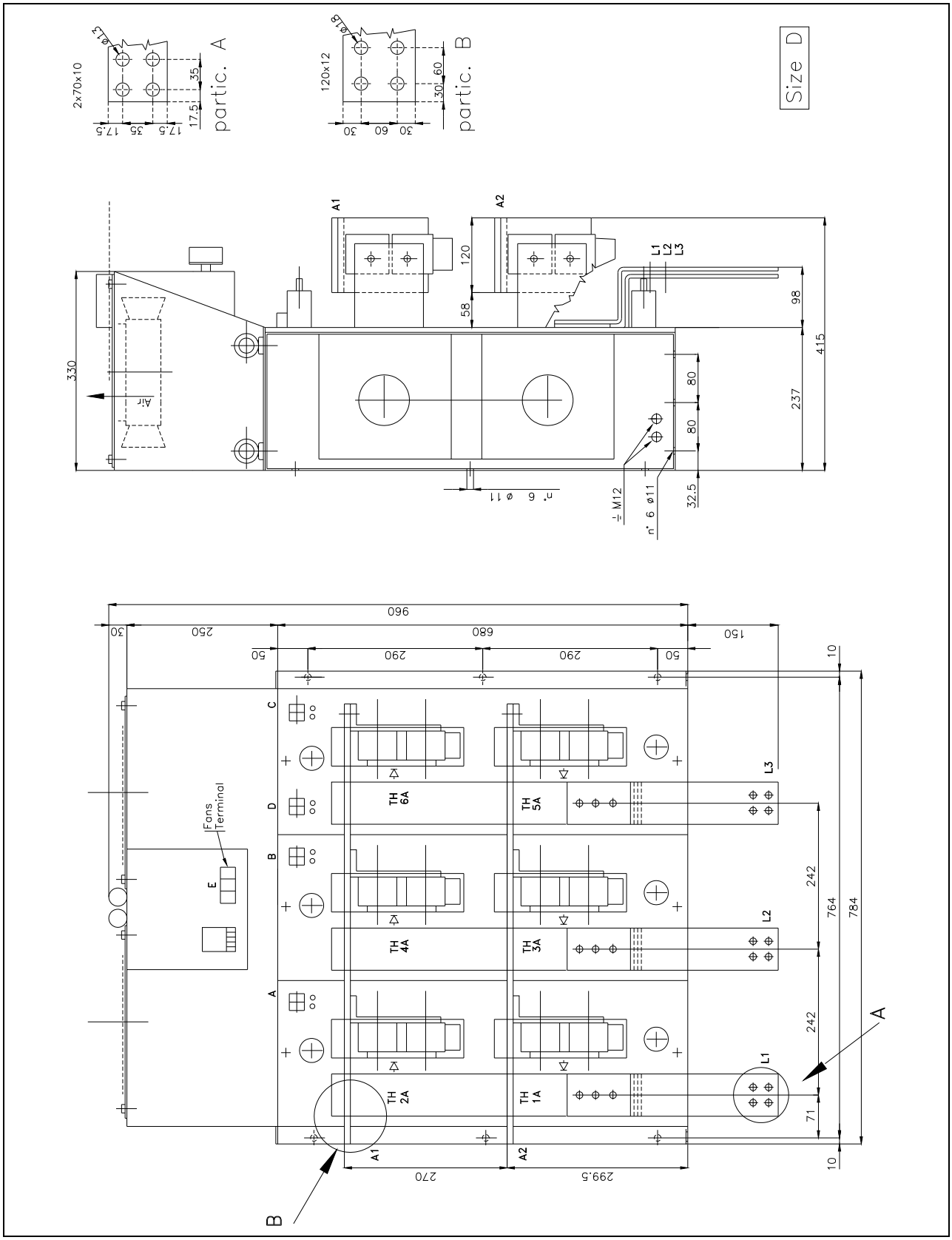
3.9 DCREG MODULAR.S SIZE B POWER SECTION OVERALL DIMENSIONS



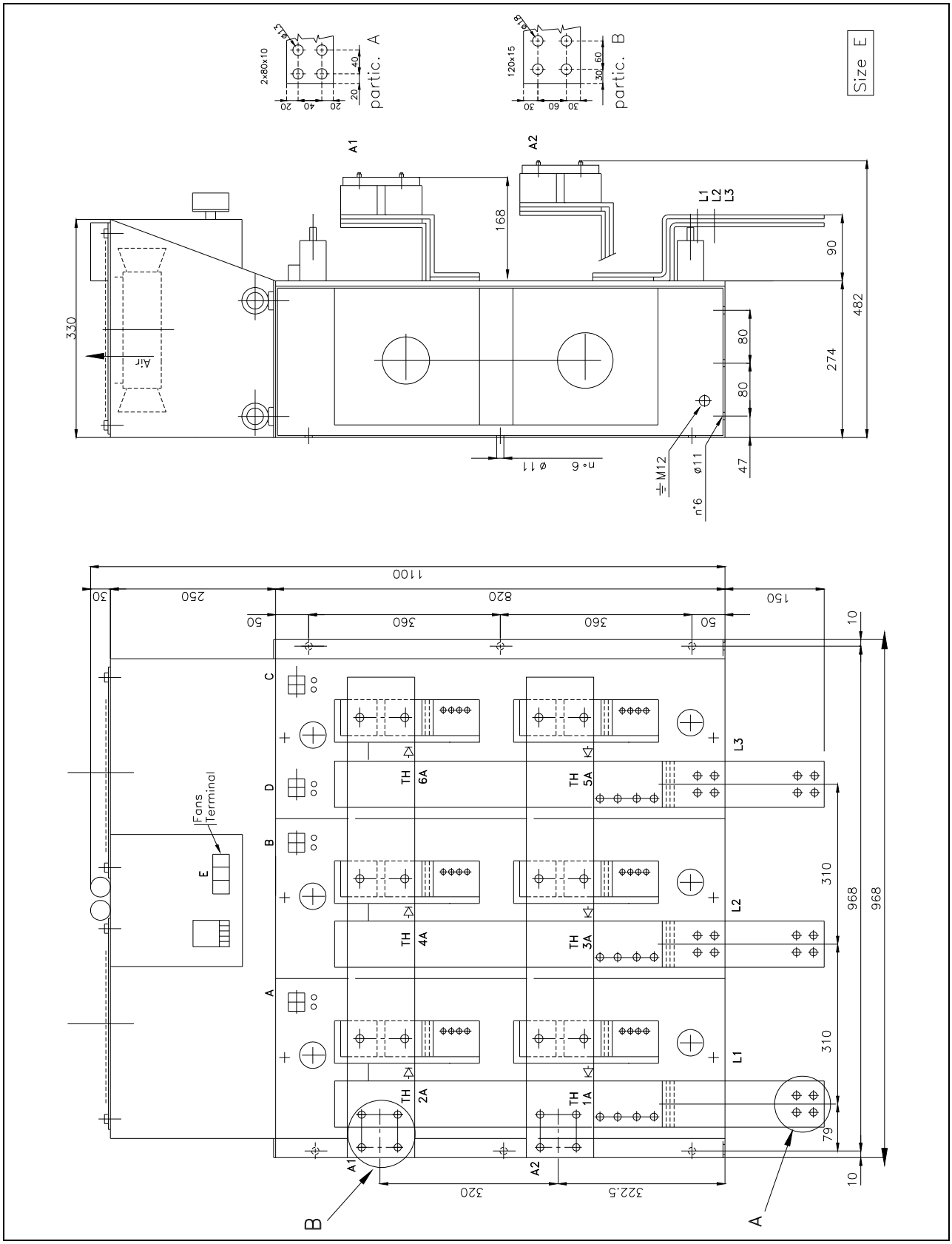
3.10 DCREG MODULAR.S SIZE C POWER SECTION OVERALL DIMENSIONS



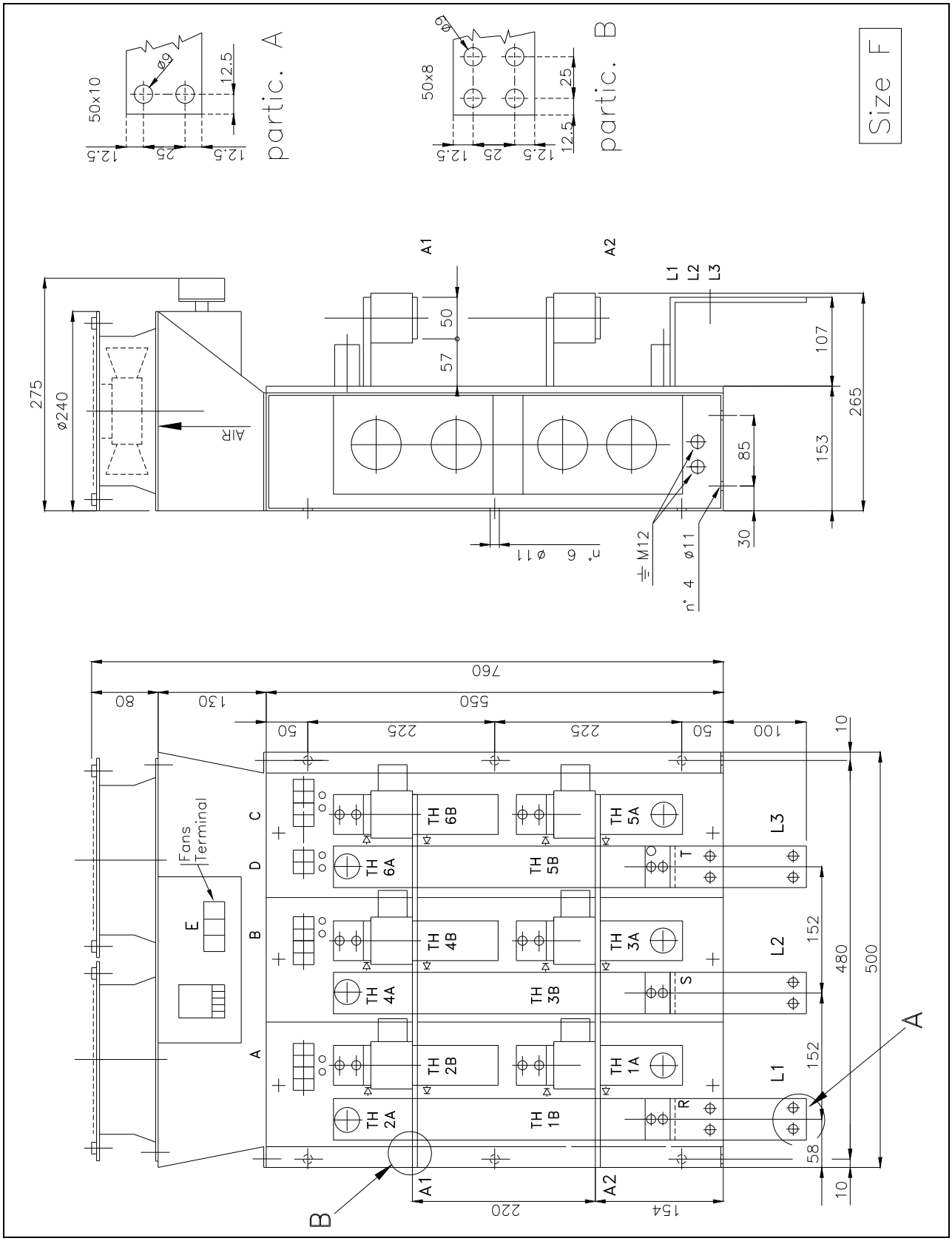
3.11 DCREG MODULAR.S SIZE D POWER SECTION OVERALL DIMENSIONS



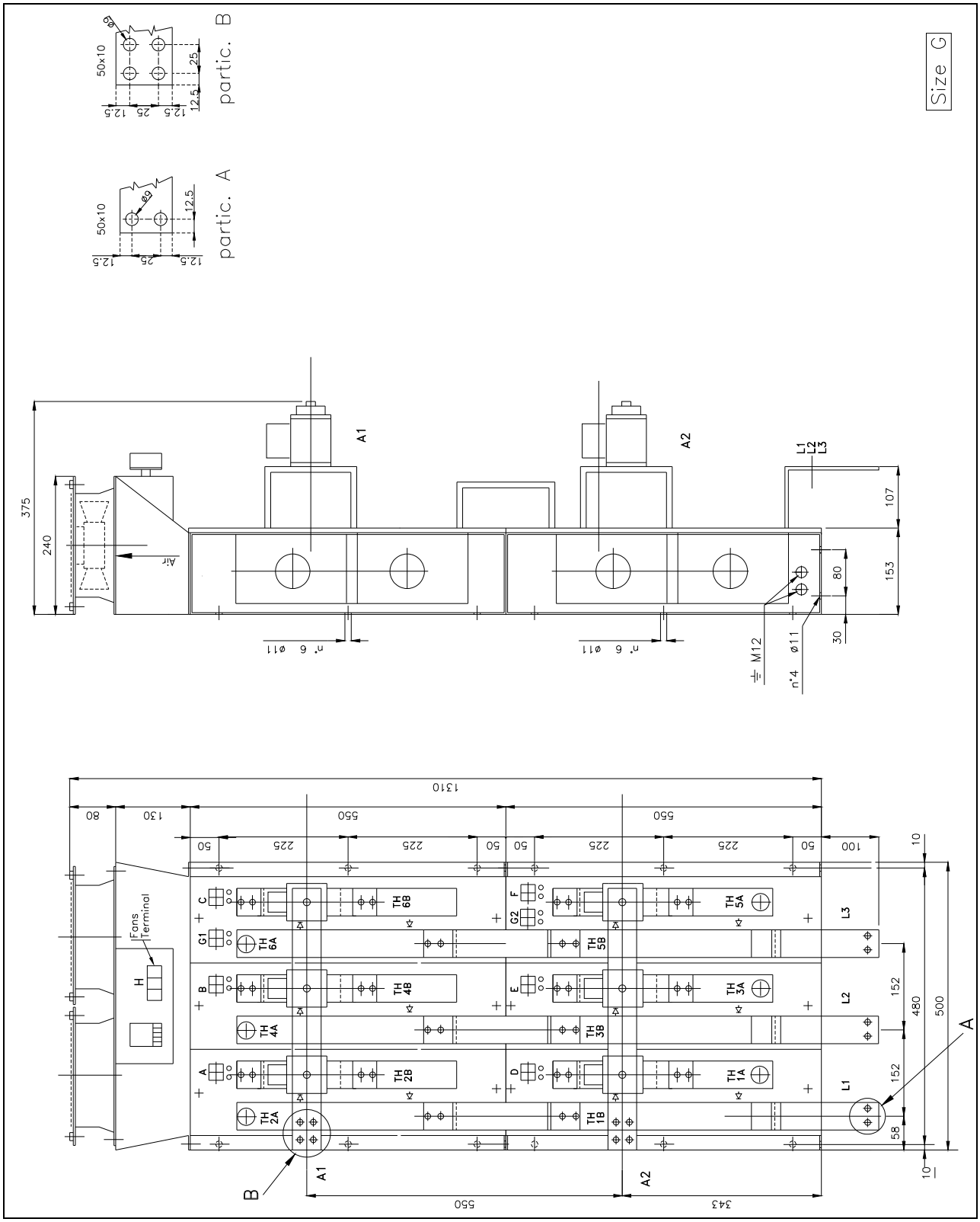
3.12 DCREG MODULAR.S SIZE E POWER SECTION OVERALL DIMENSIONS



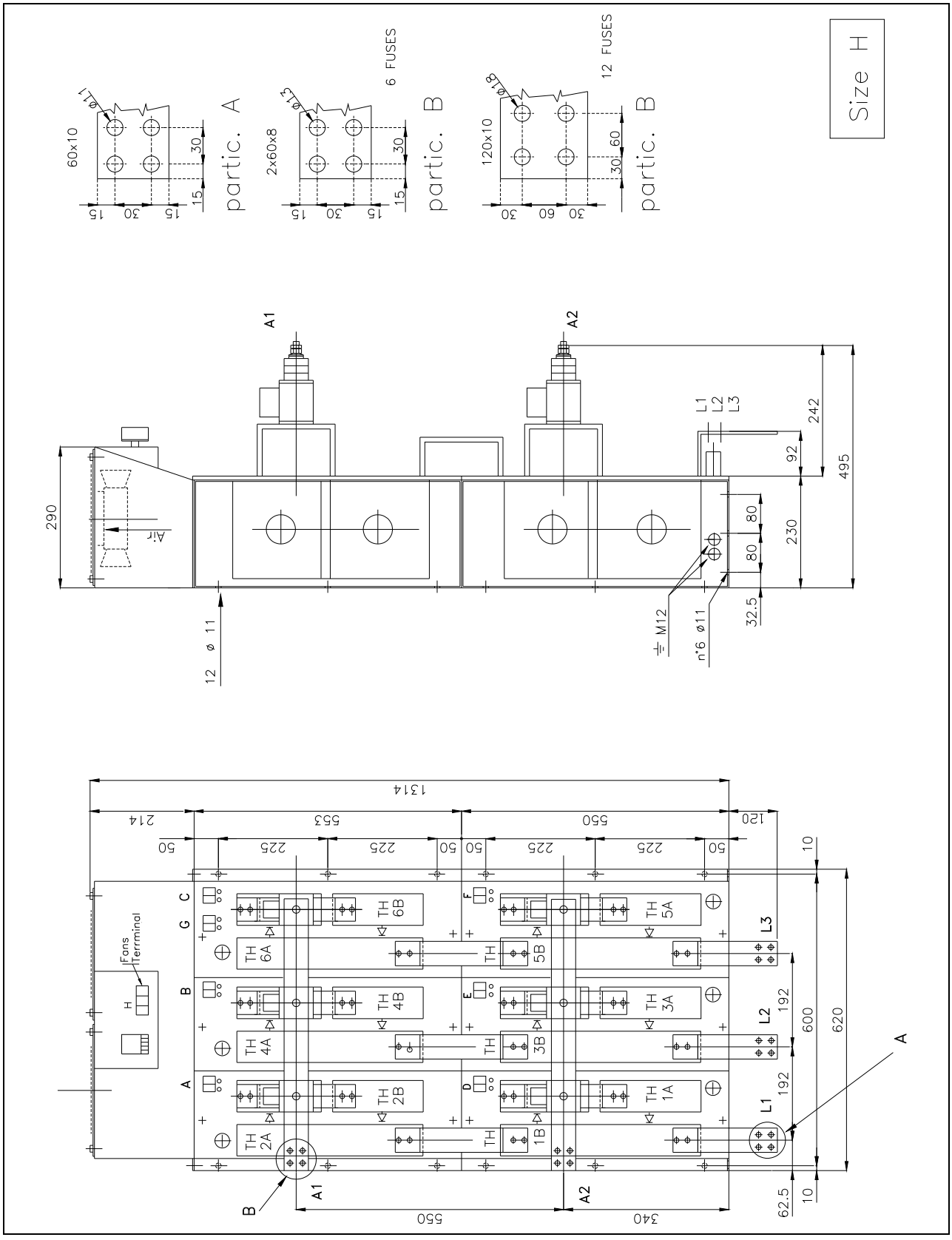
3.13 DCREG MODULAR.S SIZE F POWER SECTION OVERALL DIMENSIONS



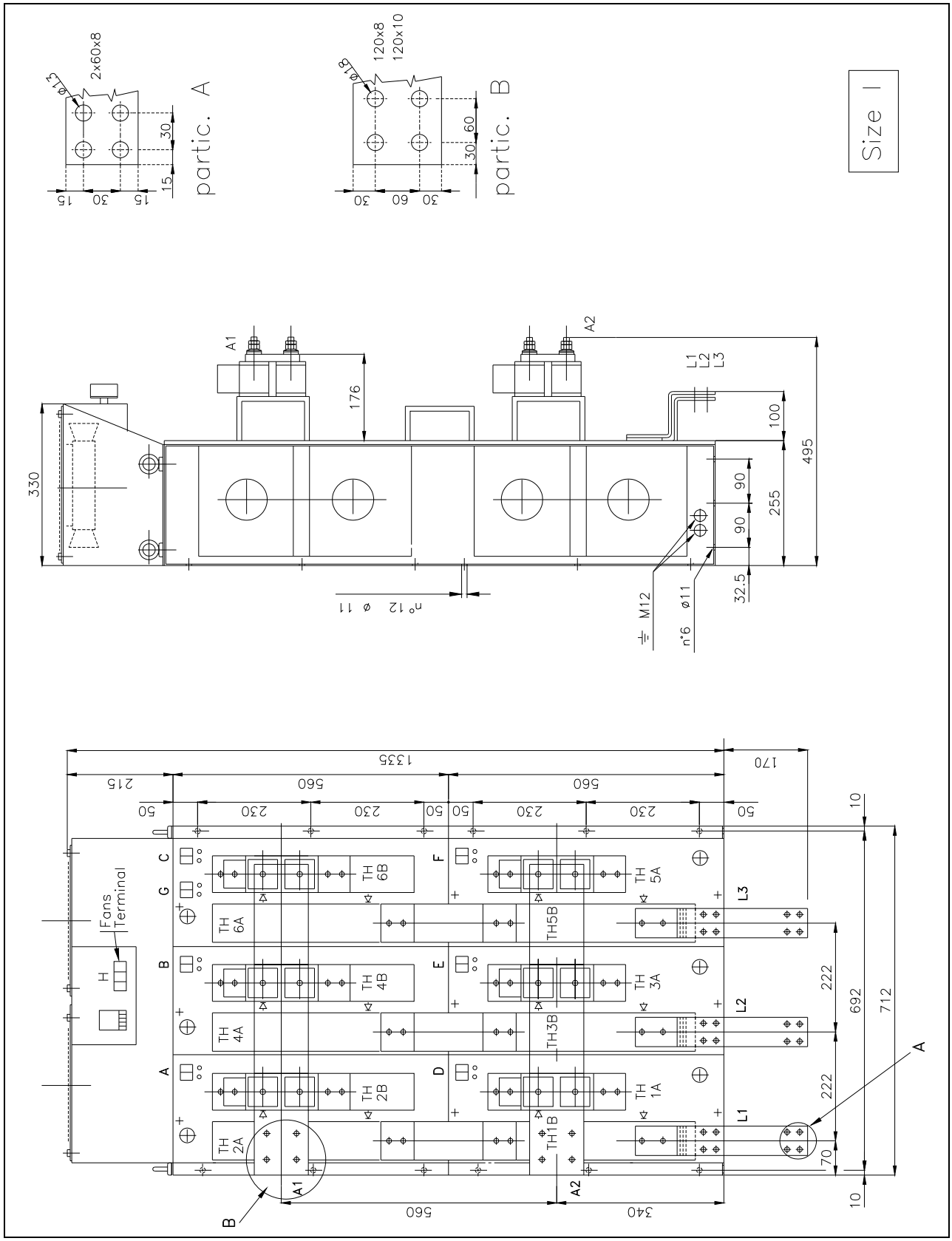
3.14 DCREG MODULAR.S SIZE G POWER SECTION OVERALL DIMENSIONS



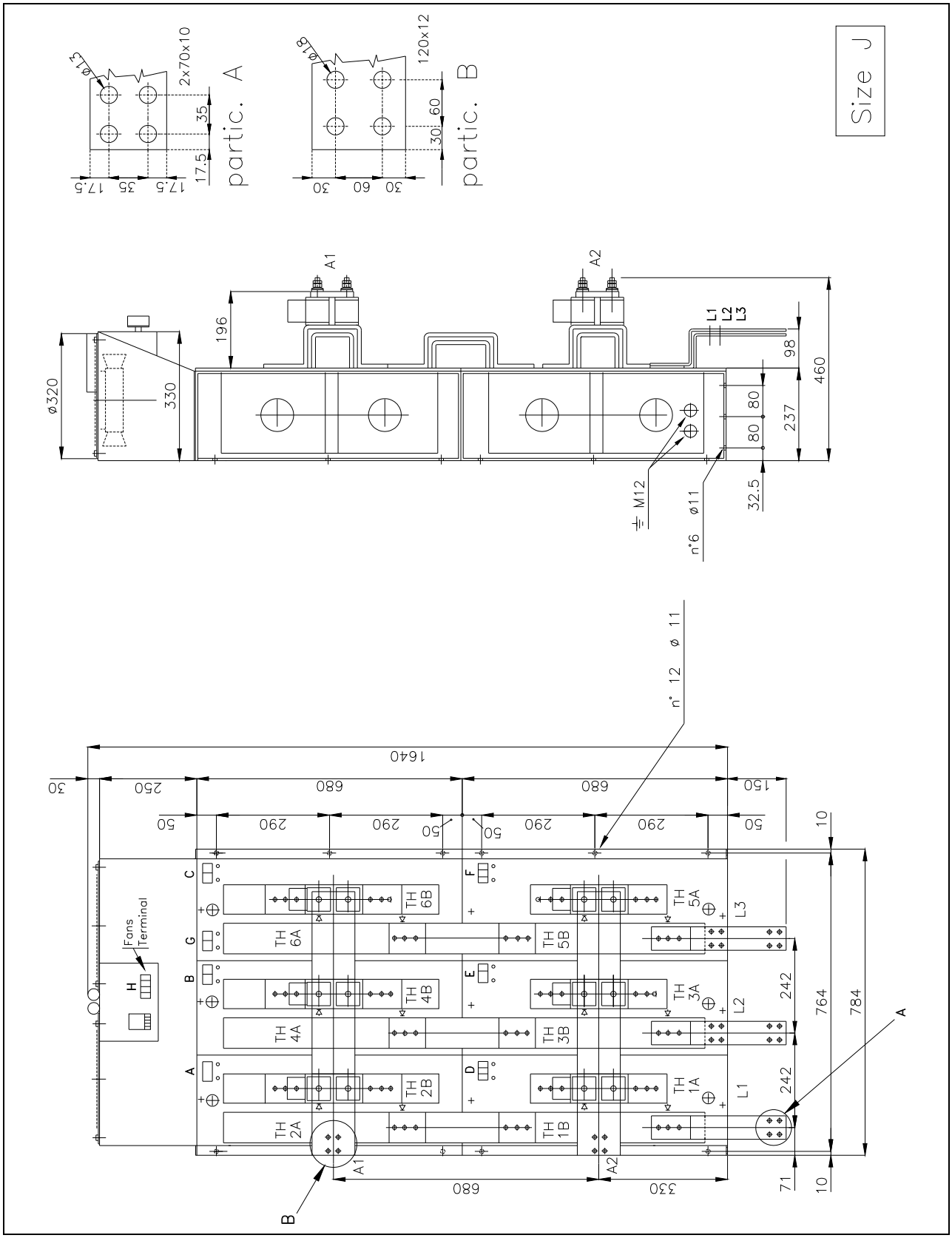
3.15 DCREG MODULAR.S SIZE H POWER SECTION OVERALL DIMENSIONS



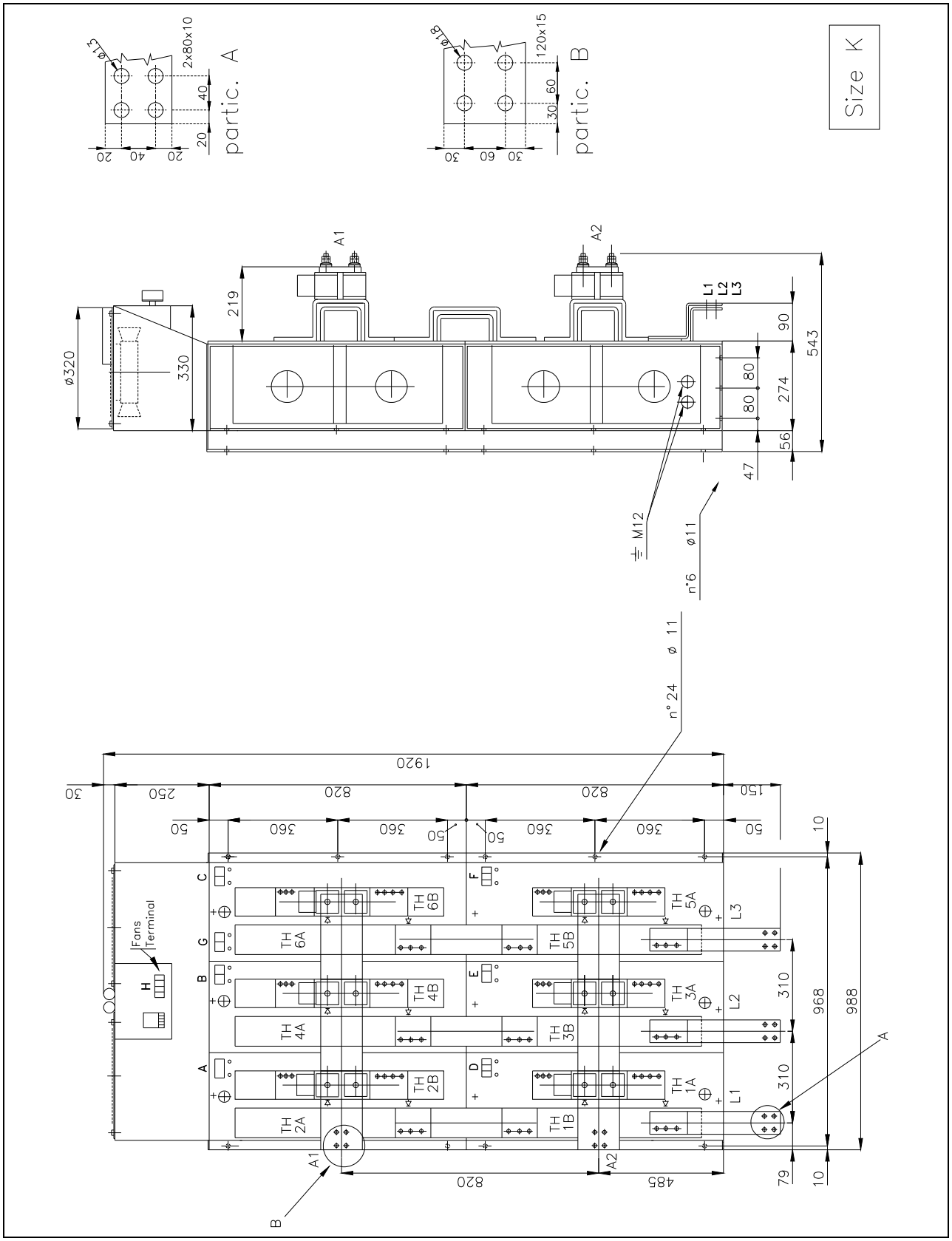
3.16 DCREG MODULAR.S SIZE I POWER SECTION OVERALL DIMENSIONS



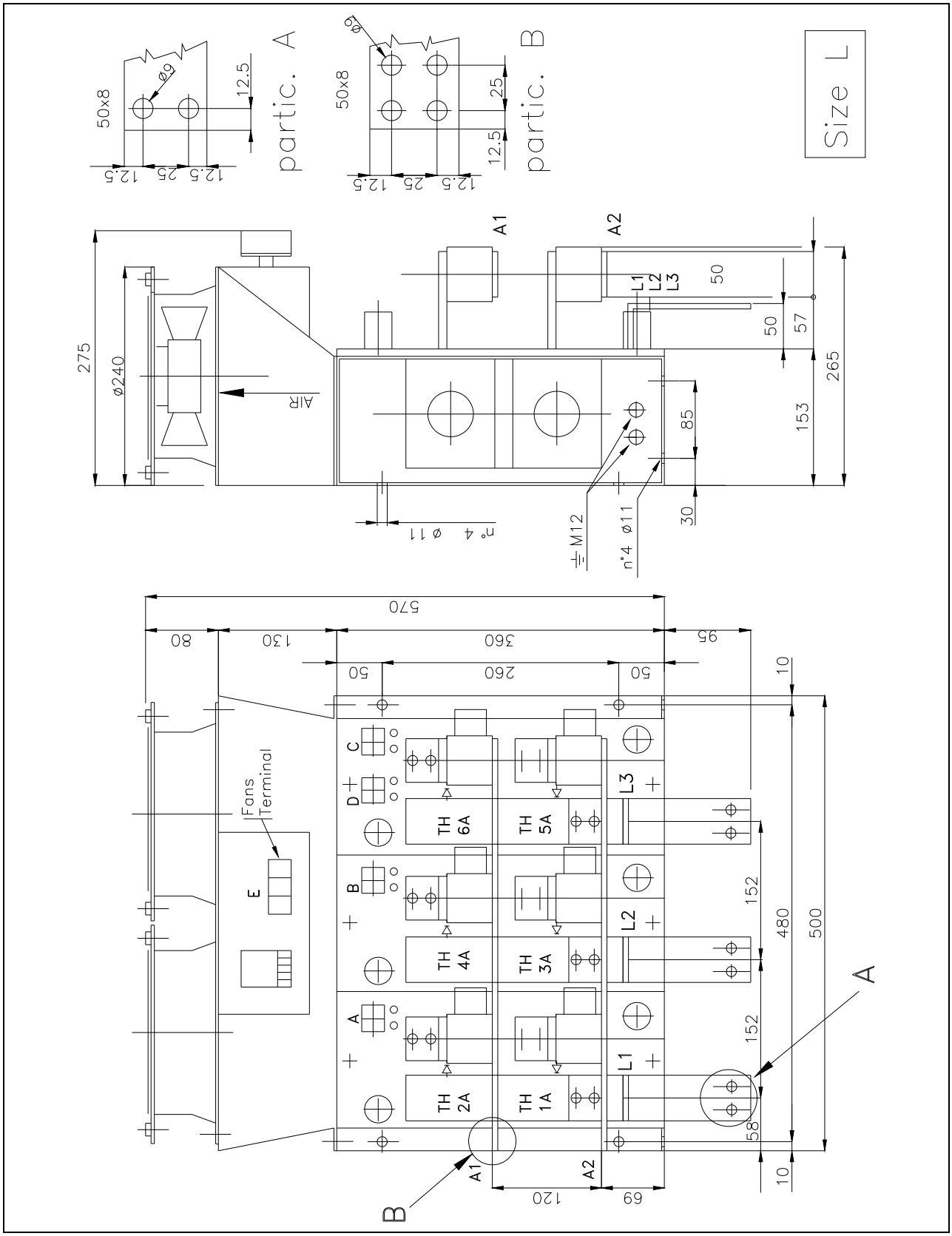
3.17 DCREG MODULAR.S SIZE J POWER SECTION OVERALL DIMENSIONS



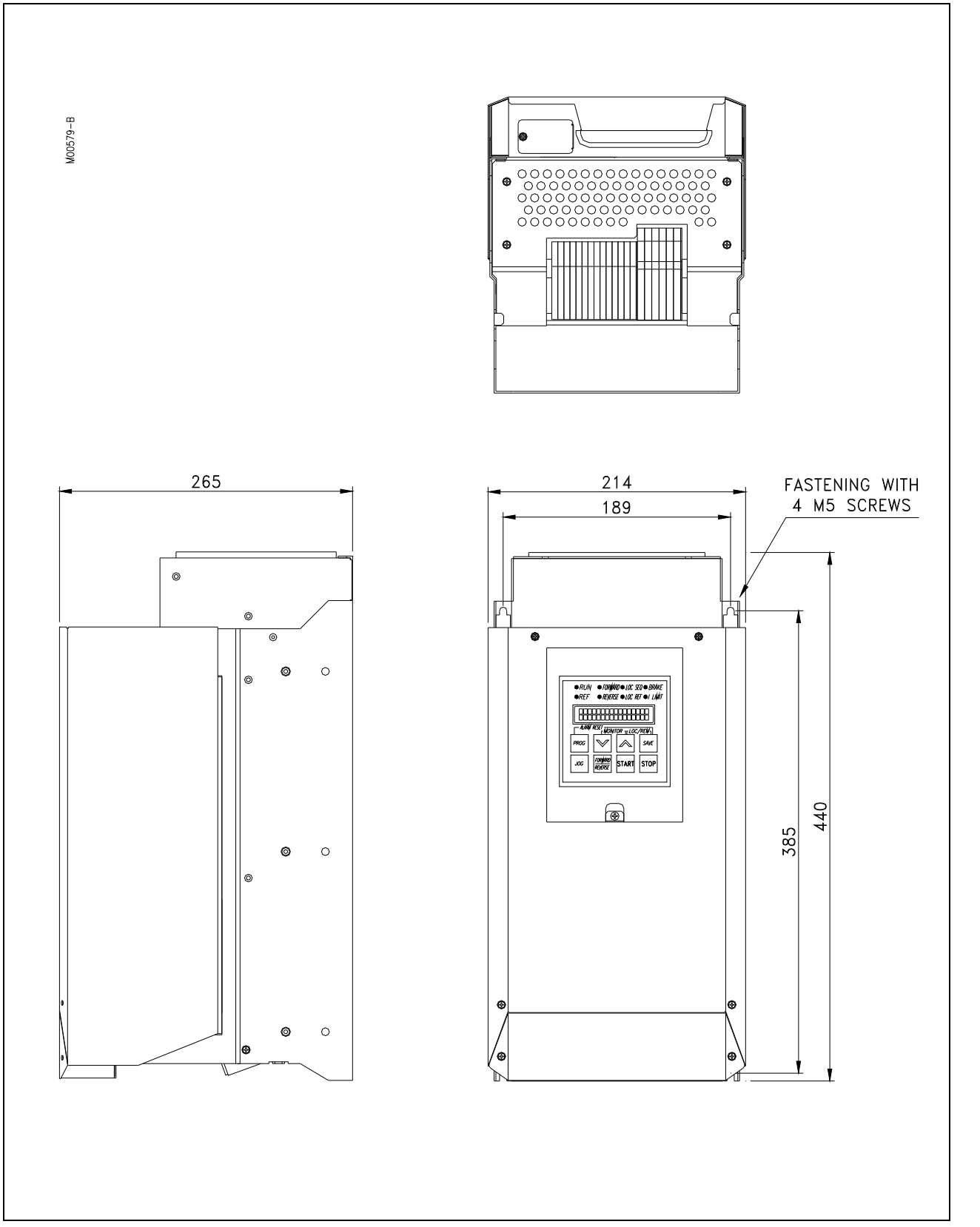
3.18 DCREG MODULAR.S SIZE K POWER SECTION OVERALL DIMENSIONS



3.19 DCREG MODULAR.S SIZE L POWER SECTION OVERALL DIMENSIONS

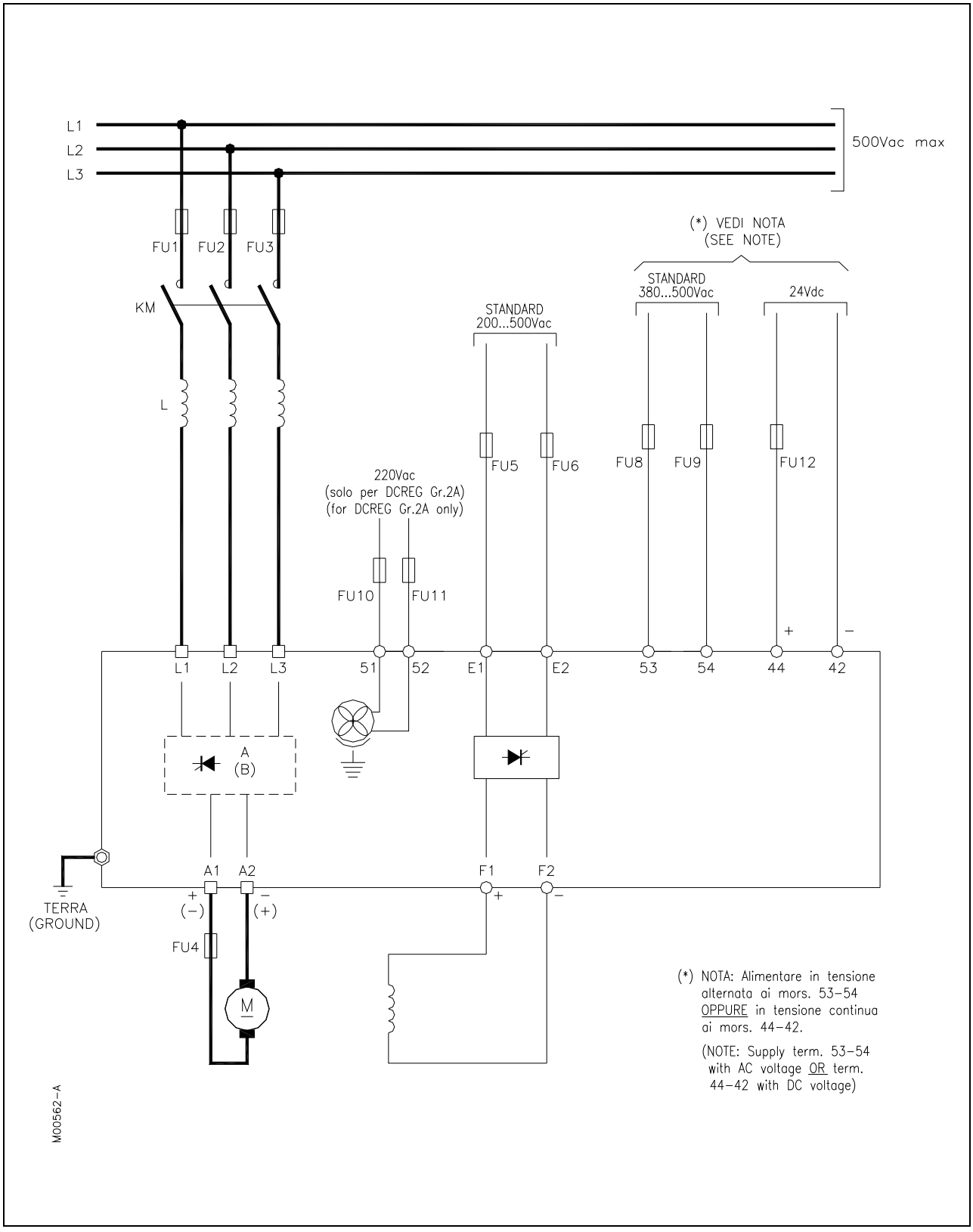


3.20 DCREG MODULAR.S CONTROL UNIT OVERALL DIMENSIONS

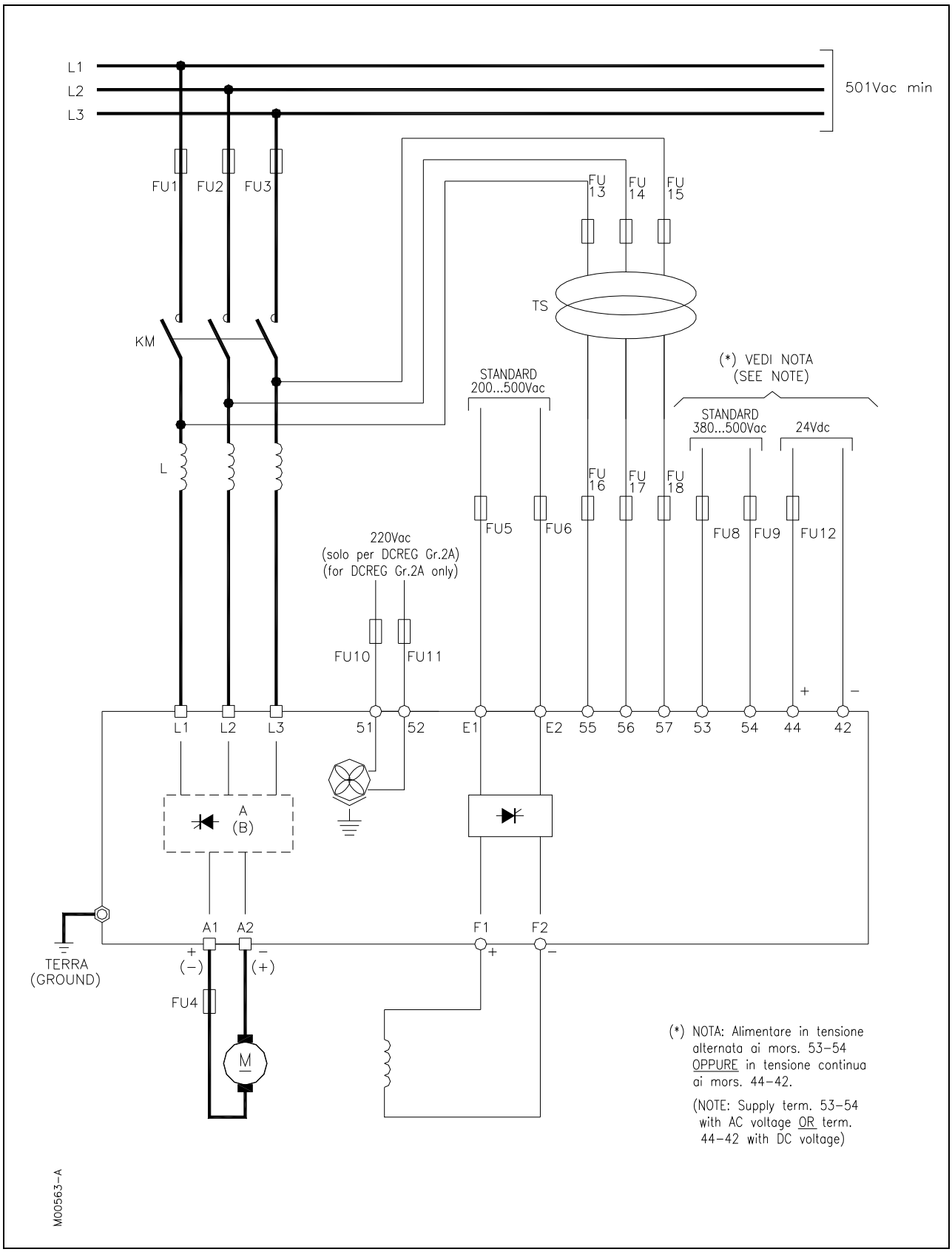


3.21 DCREG SIZE 1...2A POWER CONNECTIONS

VALID FOR DCREG SIZE1...2A FOR MAINS UP TO 500 Vac

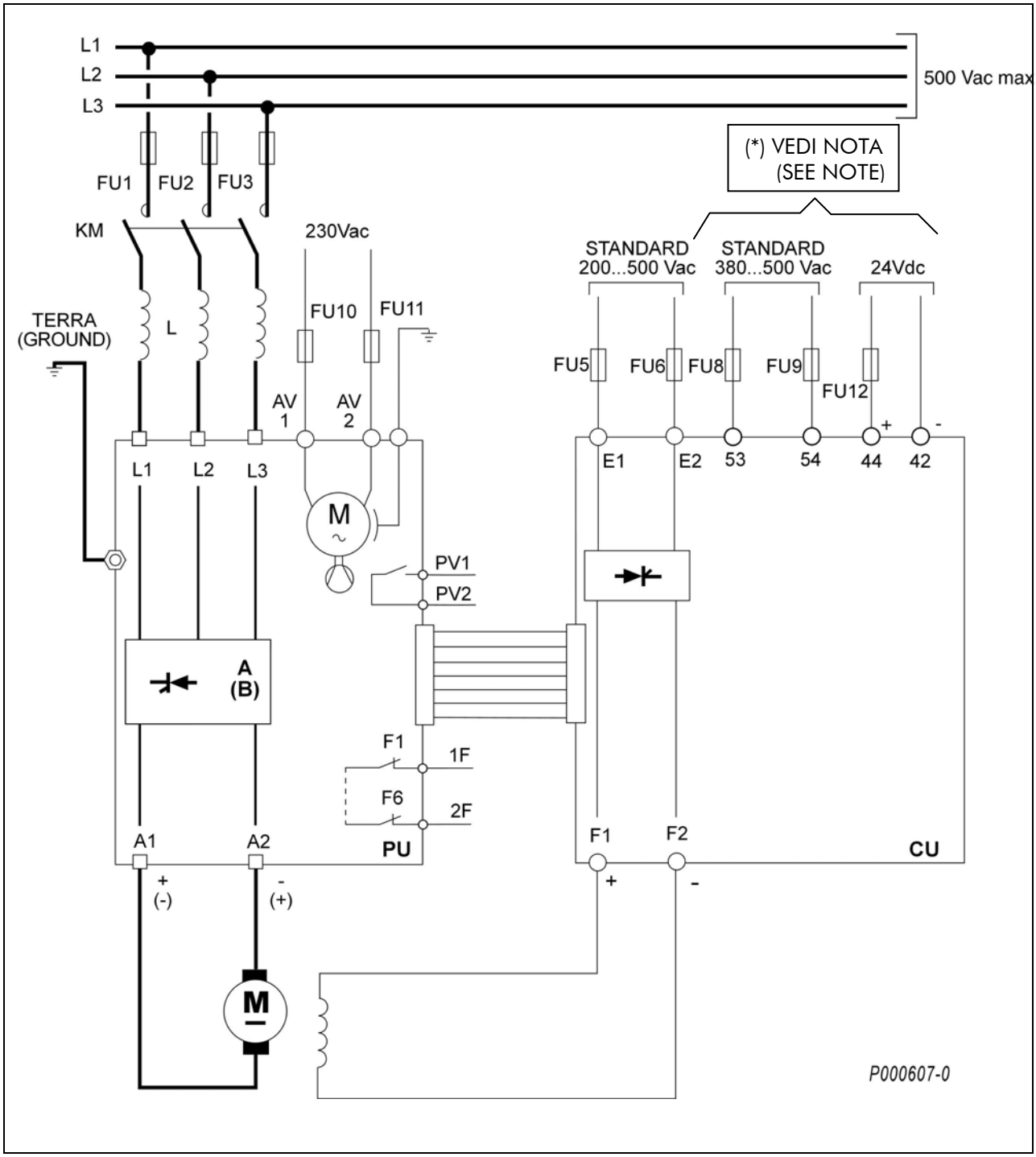


VALID FOR DCREG SIZE 1...2A FOR MAINS EXCEEDING 500 Vac



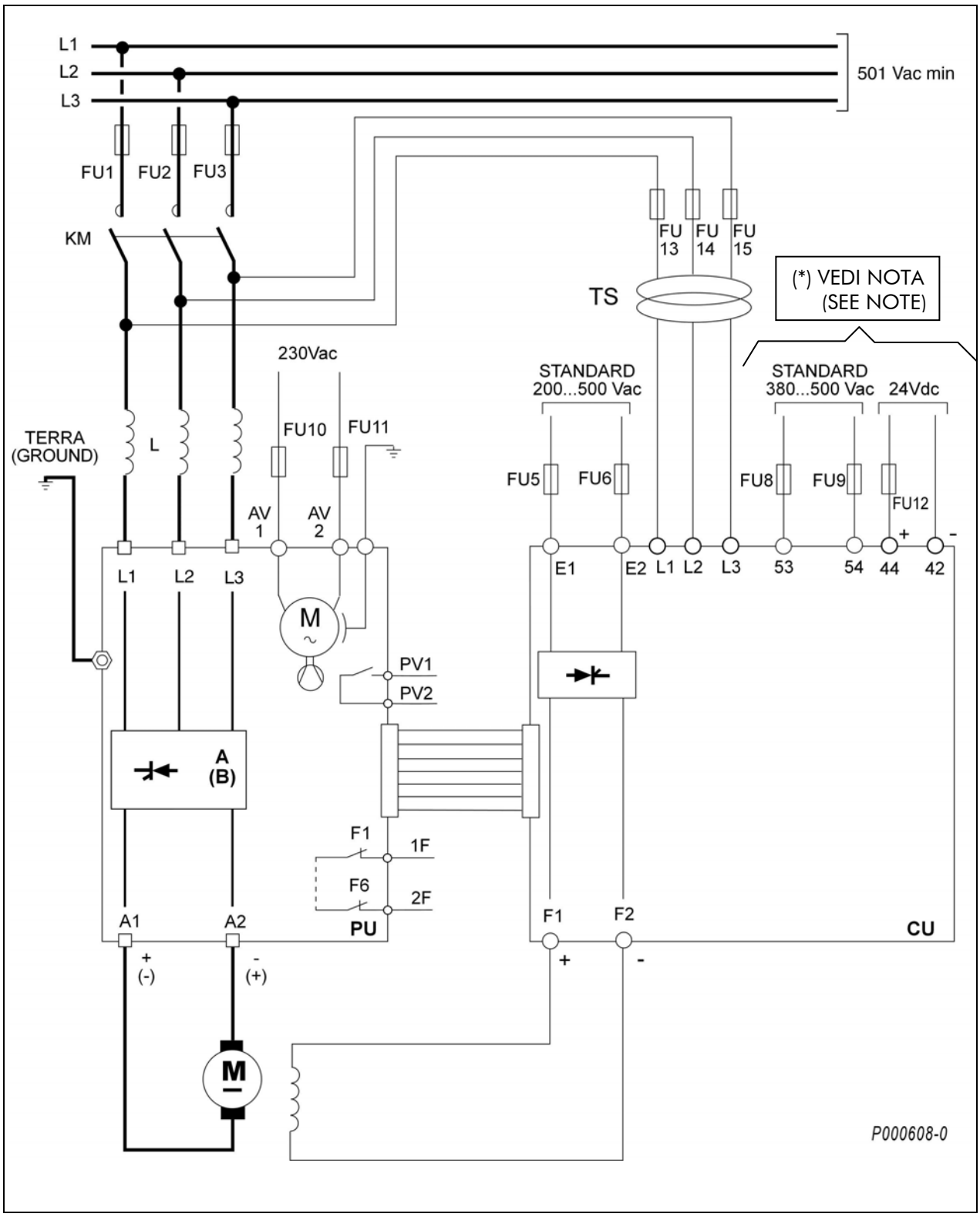
3.22 DCREG MODULAR.S POWER CONNECTIONS

VALID FOR DCREG MODULAR.S FOR MAINS UP TO 500 Vac



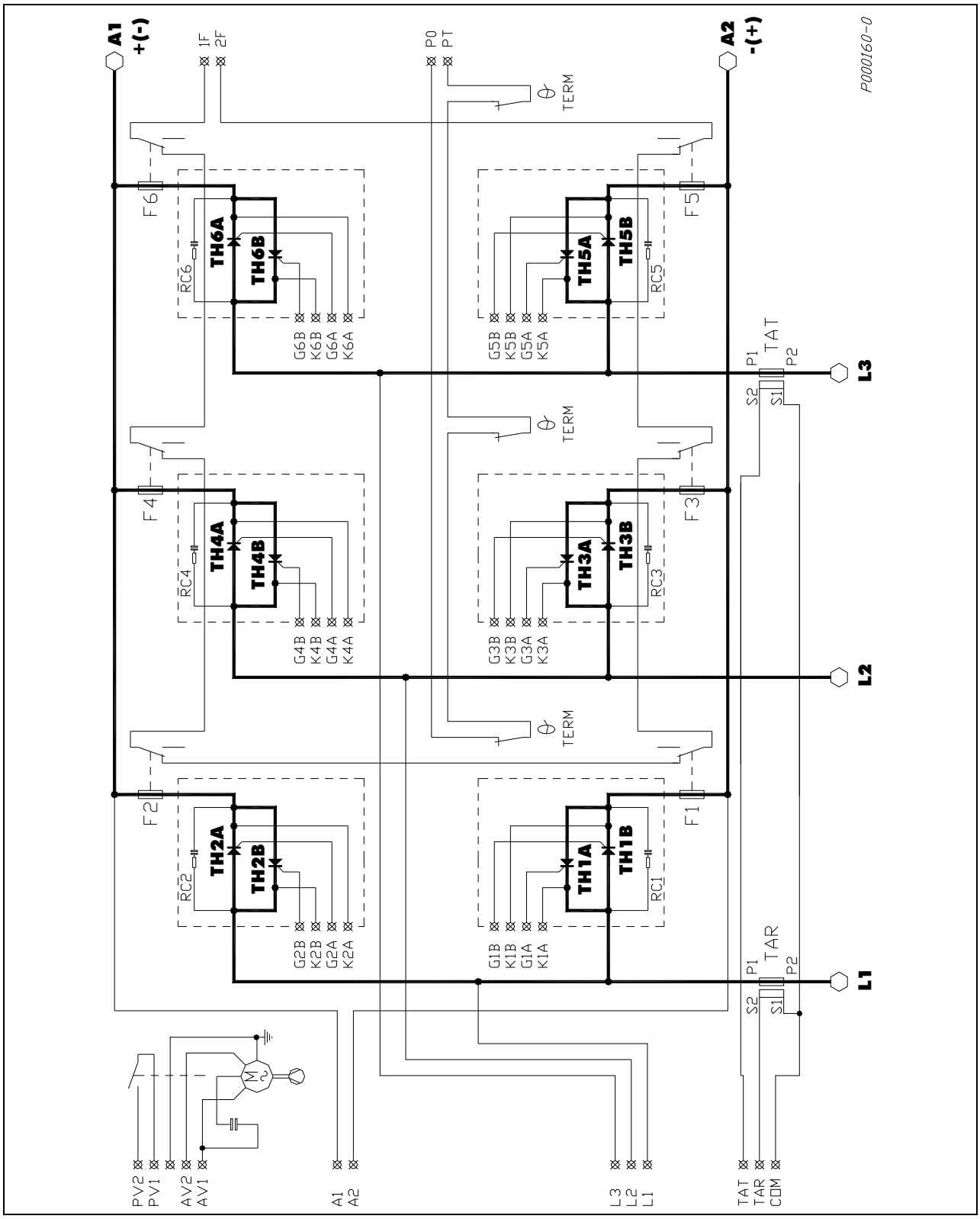
NOTE (*) : Supply term. 53-54 with AC voltage OR term. 44-42 with DC voltage.

VALID FOR DCREG MODULAR.S FOR MAINS EXCEEDING 500 Vac



NOTE (*) : Supply term. 53-54 with AC voltage OR term. 44-42 with DC voltage.

3.23 DCREG MODULAR.S POWER UNIT WIRING DIAGRAM



NOTE TH1B ... 6B thyristors (4 quadrants operation) in DCREG4 only.

3.24 DCREG MODULAR.S CONTROL UNIT TERMINALS

G1A	A bridge TH1 thyristor gate	(to terminal G1A of the Control Unit)
K1A	A bridge TH1 thyristor cathode	(to terminal K1A of the Control Unit)
G2A	A bridge TH2 thyristor gate	(to terminal G2A of the Control Unit)
K2A	A bridge TH2 thyristor cathode	(to terminal K2A of the Control Unit)
G3A	A bridge TH3 thyristor gate	(to terminal G3A of the Control Unit)
K3A	A bridge TH3 thyristor cathode	(to terminal K3A of the Control Unit)
G4A	A bridge TH4 thyristor gate	(to terminal G4A of the Control Unit)
K4A	A bridge TH4 thyristor cathode	(to terminal K4A of the Control Unit)
G5A	A bridge TH5 thyristor gate	(to terminal G5A of the Control Unit)
K5A	A bridge TH5 thyristor cathode	(to terminal K5A of the Control Unit)
G6A	A bridge TH6 thyristor gate	(to terminal G6A of the Control Unit)
K6A	A bridge TH6 thyristor cathode	(to terminal K6A of the Control Unit)
G1B	B bridge TH1 thyristor gate	(to terminal G1B of the Control Unit)
K1B	B bridge TH1 thyristor cathode	(to terminal K1B of the Control Unit)
G2B	B bridge TH2 thyristor gate	(to terminal G2B of the Control Unit)
K2B	B bridge TH2 thyristor cathode	(to terminal K2B of the Control Unit)
G3B	B bridge TH3 thyristor gate	(to terminal G3B of the Control Unit)
K3B	B bridge TH3 thyristor cathode	(to terminal K3B of the Control Unit)
G4B	B bridge TH4 thyristor gate	(to terminal G4B of the Control Unit)
K4B	B bridge TH4 thyristor cathode	(to terminal K4B of the Control Unit)
G5B	B bridge TH5 thyristor gate	(to terminal G5B of the Control Unit)
K5B	B bridge TH5 thyristor cathode	(to terminal K5B of the Control Unit)
G6B	B bridge TH6 thyristor gate	(to terminal G6B of the Control Unit)
K6B	B bridge TH6 thyristor cathode	(to terminal K6B of the Control Unit)
P0	Thermo-switches series common	(to terminal P0 of the Control Unit)
PT	Thermo-switches series NC	(to terminal PT of the Control Unit)
L1	L1 bar potential	(Note 1)
L2	L2 bar potential	(Note 1)
L3	L3 bar potential	(Note 1)
A1	A1 bar potential	(to terminal A1 of the Control Unit)
A2	A2 bar potential	(to terminal A2 of the Control Unit)
COM	Current transformers common	(to terminal COM of the Control Unit)
TAR	TAR current transformer output	(to terminal TAR of the Control Unit)
TAT	TAT current transformer output	(to terminal TAT of the Control Unit)

N.B.: TH1B .. 6B thyristors in DCREG4 type only.

(1) NOTE: Terminals L1-L2-L3 in the Control Unit are to be respectively connected to terminals L1-L2-L3 in the Power Unit in case of a mains up to 500Vac, whereas they have to be directly connected to the secondary in three-phase transformer TS in case of a mains exceeding 500Vac. In the latter case, terminals L1-L2-L3 in the Power Unit have to be left disconnected.

3.25 SUPPLY AND POWER TERMINALS

Terminal	Description	Notes
L1 L2 L3	Input bars for armature rectifier three-phase bridge power supply.	Standard 440Vac max Electrical connection: DCREG Size 1: 3xM8 (tightening torque: 12Nm) DCREG Size 2 600Amax: 3xM10 DCREG Size 2 750Amin and Size 2A: 3xM12 DCREG MODULAR.S: see Power Section Overall Dimensions
A1 A2	Direct current output bars for motor armature DC power supply. Positive potential on bar A1 compared to bar A2, with positive speed reference and drive not in regeneration state.	Standard 600Vdc for DCREG2 520Vdc per DCREG4 Electrical connection: DCREG Size 1: 2xM8 (tightening torque: 12Nm) DCREG Size 2 600Amax: 2xM10 DCREG Size 2 750Amin and Size 2A: 2xM12 DCREG MODULAR.S: see Power Section Overall Dimensions
E1 E2	Input for field single-phase bridge power supply.	Standard 200 … 500Vac DCREG.100max: 5A max, DCREG.150min Size 1:15A max (tightening torque: 2.5÷3Nm) DCREG Size 2(A) e MODULAR.S: 35A max
F1 F2	Direct voltage output for motor field DC power supply. Positive potential on terminal F1 compared to terminal F2.	Standard 425Vdc max for DCREG2/4 DCREG.100max: 5A max, DCREG.150min Size 1:15A max (tightening torque: 2.5÷3Nm) DCREG Size 2(A) and MODULAR.S: 35A max
PV1 PV2	Cooling fans alarm relay contact.	Available on DCREG MODULAR.S only To be introduced in external sequence for any alarm signal
1F 2F	Internal ultrafast fuses micro-switches series.	Available on DCREG MODULAR.S only To be introduced in external sequence for any alarm signal
42 44	Input for control section from 24Vdc direct voltage. Positive potential on terminal 44 compared to terminal 42.	24Vdc, 1.8A max (tightening torque: 0.5Nm)
51-52 (AV1-AV2)	Single-phase alternating voltage input for cooling fans power supply. Note: not available for DCREG Size 1-2.	DCREG Size 2A: 230Vac, 1.5A DCREG MODULAR.S: 230Vac, 1.3A max
53 54	Input for control section power supply from single-phase alternating voltage.	Standard 380 … 500Vac. See note (1) (tightening torque: 0.4÷0.6Nm)
55 56 57	Input for synchronizing phases from TS transformer secondary. N.b.: terminals available on DCREG Size 1 … 2A only, for supply mains higher than 500Vac.	500Vac max

(1) Note: If the control section is to be supplied with a single-phase alternating voltage, the max. voltage to be applied to terminals 53-54 is 500Vac. For the mains up to 690Vac, ELETTRONICA SANTERNO may supply a single-phase, 700/500V transformer, 150VA, code TR0112260.

3.26 LEGEND FOR POWER CONNECTIONS

A(B)	AC/DC conversion bridge. N.B.: for DCREG2, the polarities in brackets for bars A1 and A2 refer to the regenerative operation.
CU	Control unit for DCREG MODULAR.S.
FU1-2-3	Ultrafast fuses for DCREG Size 1... 2A. Fast-acting fuses for DCREG MODULAR.S: in this case, fuses can be replaced by an automatic circuit breaker.
FU4	Direct current side ultrafast fuse for AC/DC bridge protection. N.B.: This is required for DCREG2 Size 1 ... 2A for regenerative operation only, and for DCREG4 Size 1 ... 2A.
FU5-6	Ultrafast fuses protecting the field half-controlled rectifier bridge.
FU8-9	1A fast-acting fuses protecting the connection to terminals 53/54 to the power supply mains.
FU10-11	2.5A fuses for DCREG Size 2A and DCREG MODULAR.S only, for air-cooling unit.
FU12	2.5A fast-acting fuses for internal switching.
FU13-14-15	1A delay fuses over transformer TS primary.
FU16-17-18	1A delay fuses over transformer TS secondary. N.B.: they are required for DCREG Size 1 ... 2A only and for a power supply exceeding 500Vac.
KM	AC/DC bridge power supply contactor. In case of DCREG MODULAR.S, contactor can be replaced by an automatic circuit breaker.
L	Switching three-phase impedance.
L1-2-3	50/60Hz three-phase mains.
M	Direct current motor (armature circuit + field circuit).
PU	DCREG MODULAR.S power unit.
TS	Three-phase 50VA 700/500V transformer: phase shift 0°. ELETTRONICA SANTERNO code: TR0108007. N.B.: This is required for power supply values exceeding 500Vac.

NOTE

Whenever requested, it is recommended to use ULTRAFAST FUSES of the same type and value indicated on TECHNICAL CHARACTERISTICS tables, so as to avoid possible damages of the converter.

NOTE

Always install a three-phase remote control switch on the A.C. side, together with a suitable NO auxiliary contact directly in the terminal 24 (*ENABLE*) series, as indicated in the SIGNAL CONNECTIONS diagram. Do not connect other single-phase or three-phase loads in parallel to bars L1, L2, L3, since the remote control switch should only supply the above mentioned bars through the three-phase impedance.

NOTE

DO NOT OPEN the remote control switch during the braking phase with regeneration towards the mains.

NOTE

To optimise the rotation stability on a DCREG4-type converter, it is recommended to disable the possible STABILIZATION SERIES which has been fit on the motor winding.

3.27 SWITCHING THREE-PHASE INDUCTANCE

A three-phase inductance is to be inserted into the power supply line. The inductance is aimed at:

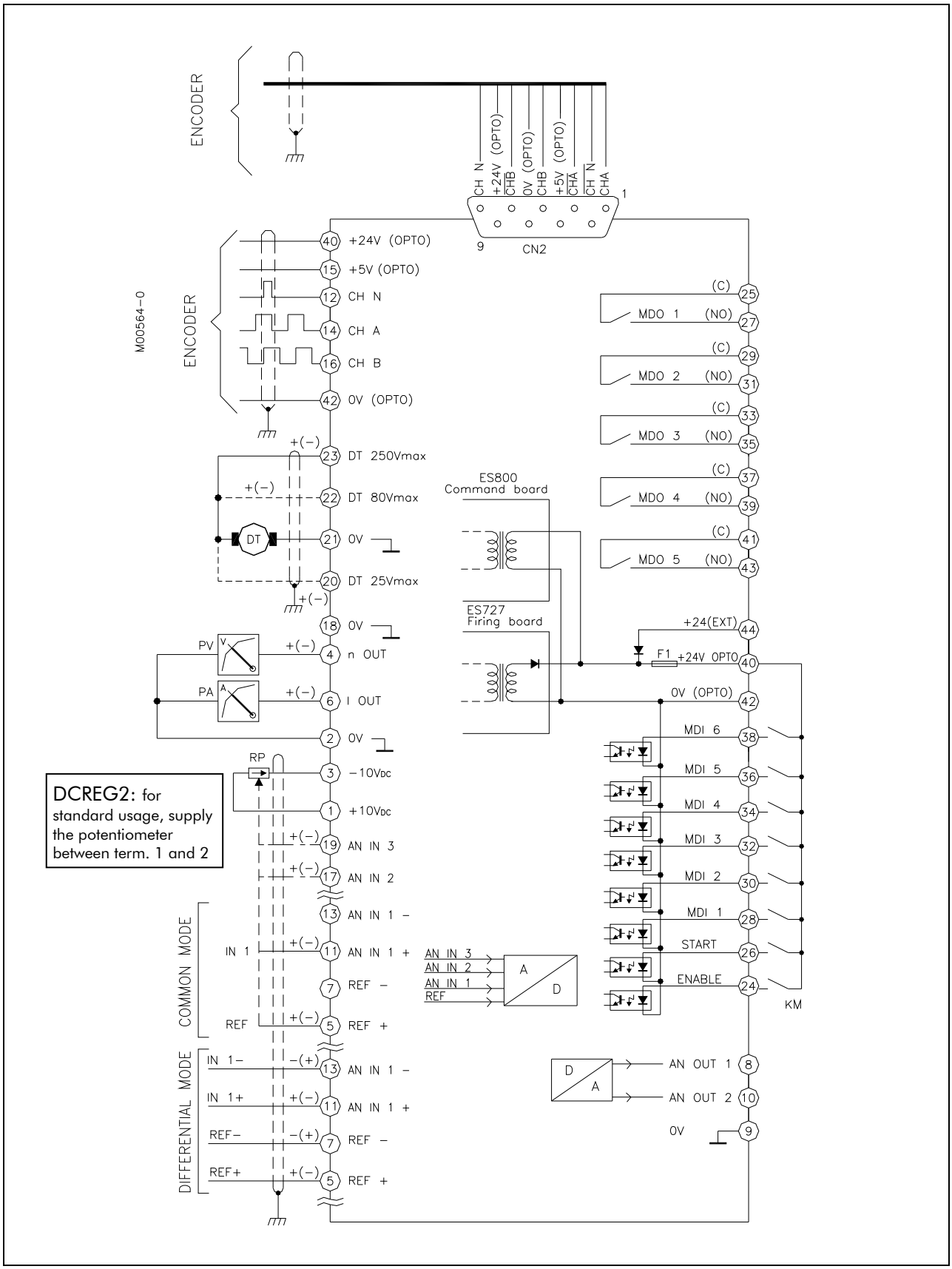
- Reducing the mains voltage distortions from the sinusoidal form in the drive connecting point.
- Reducing the line current gradients which may cause both radio interferences and induced interferences in the close lines.

Two series of three-phase inductances are available, named L2 and L4.
They have a different inductance value, i.e. a different phase drop (approx. 6V for the L2-type and 1V for the L4-type): L2-type shows a better performance than L4-type.

The table below shows the inductance specifications depending on the converter size and by referring to the power supply voltage values to be applied.

Drive size	INDUCTANCE L2 @ 500V TYPE	INDUCTANCE L2 @ 600-690V TYPE	INDUCTANCE L4 TYPE
	Code	Code	Code
DCREG.10	IM0126004 - 2000µH	IM0127004 - 3451µH	3 x IM0100354 - 150µH
DCREG.20	IM0126044 - 1273µH	IM0127044 - 2196µH	3 x IM0100354 - 150µH
DCREG.40	IM0126084 - 700µH	IM0127084 - 1208µH	3 x IM0100354 - 150µH
DCREG.70	IM0126164 - 239µH	IM0127164 - 412µH	IM0122104 - 45µH
DCREG.100	IM0126164 - 239µH	IM0127164 - 412µH	IM0122154 - 30µH
DCREG.150	IM0126204 - 156µH	IM0127204 - 268µH	IM0122154 - 30µH
DCREG.180	IM0126244 - 88µH	IM0127244 - 151µH	IM0122204 - 20µH
DCREG.250	IM0126244 - 88µH	IM0127244 - 151µH	IM0122254 - 15µH
DCREG.350	IM0126284 - 61µH	IM0127284 - 105µH	IM0122304 - 10µH
DCREG.410	IM0126284 - 61µH	IM0127284 - 105µH	IM0122304 - 10µH
DCREG.500	IM0126324 - 54µH	IM0127324 - 93µH	IM0122404 - 6.2µH
DCREG.600	IM0126364 - 33µH	IM0127364 - 58µH	IM0122404 - 6.2µH
DCREG.750	-	IM0127364 - 58µH	IM0122504 - 4.5µH
DCREG.900	IM0126404 - 23µH	IM0127404 - 40µH	IM0122504 - 4.5µH
DCREG.1050	-	IM0127404 - 40µH	IM0122604 - 3µH
DCREG.1200	IM0126404 - 23µH	-	IM0122604 - 3µH
DCREG.1250	-	IM0127444 - 30µH	IM0122604 - 3µH
DCREG.1400	IM0126444 - 18µH	-	IM0122704 - 2.5µH
DCREG.1600	IM0126444 - 18µH	IM0127444 - 30µH	IM0122704 - 2.5µH
DCREG.1800	IM0126484 - 11µH	IM0127484 - 18µH	IM0122804 - 1.6µH
DCREG.2000	IM0126484 - 11µH	IM0127484 - 18µH	IM0122804 - 1.6µH
DCREG.2300	IM0126484 - 11µH	IM0127484 - 18µH	IM0122804 - 1.6µH
DCREG.2500	IM0126484 - 11µH	IM0127484 - 18µH	IM0122804 - 1.6µH
DCREG.2700	IM0126524 - 8µH	IM0127524 - 13µH	IM0122904 - 1.1µH
DCREG.3000	IM0126524 - 8µH	IM0127524 - 13µH	IM0122904 - 1.1µH
DCREG.3500	IM0126524 - 8µH	IM0127524 - 13µH	IM0122904 - 1.1µH
DCREG.4500	-	-	-

3.28 DCREG SIGNAL CONNECTIONS



3.29 SIGNAL TERMINALS

TERM.	Description	I/O Ratings
1	**+10V**: +10V reference voltage output for analog inputs.	$+10V_{DC}$ / 10mA max
2	**0V**: Zerovolt.	-
3	**-10V**: -10V reference voltage output for analog inputs.	$-10V_{DC}$ / 10mA max
4	**n OUT**: Speed signal output for tachometer or any other use. Positive polarity with bridge A running (not in regenerative state). The value 10V corresponds to the max. speed (voltage) feedback signal, i.e. parameter M001 (*nFdbk*) is equal to 100%. If the drive is in armature feedback mode, this output is not enabled.	-10 ... $+10V_{DC}$ 5mA max
5-7	**REF**: Main analog input (**5: REF+ / 7: REF-**). If both signal wires are connected, the two terminals represent a differential input with a high rejection to interferences. Alternatively, with a signal to be reflected to the drive 0V, the two terminals represent a common mode input. This common mode input is a non-reversing input if the signal "hot wire" is connected to terminal 5 when terminal 7 is disconnected, whereas it is a reversing input if it is connected to terminal 7 when terminal 5 is disconnected. By setting jumper JP7 in terminal board ES801 (JP407 in ES906) on pos. 2-3, the two terminals will represent an input for a signal expressed in milliAmperes: a positive reference is generated if the current enters terminal 5 and goes out through terminal 7. See also the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.	JP7 on pos. 1-2: -10 ... $+10V_{DC}$ R_{in} = 20kΩ JP7 on pos. 2-3: 20mA max R_{in} = 200Ω
6	**I OUT**: Current signal output (filtered) for possible ammeter, or different use. Positive polarity with bridge A in operation. The value is 6.67V according to the rated current of the drive (i.e. 100A for a DCREG.100). In case of a DCREG4, the mentioned signal can be set as bipolar or unipolar by means of the parameter P156 (*IOutPol*).	-10 ... $+10V_{DC}$
8	**OUT 1**: Analog output 1 to be configured with parameter P150 (*AnOut1Cfg*). By setting jumper JP9 in terminal board ES801 (JP409 in ES906) on pos. 1-2, the terminal will represent an output for a voltage signal, while when the jumper is set on pos. 2-3, the terminal will represent an output for a signal expressed in milliAmperes. An outgoing current only may be produced towards 0V potential. See also the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.	JP9 on pos. 1-2: -10 ... $+10V_{DC}$ 5mA max JP9 on pos. 2-3: 0 ... 20mA 10V max
9	**0V**: Zerovolt.	-
10	**OUT 2**: Analog output 2 to be configured through parameter P153 (*AnOut2Cfg*). By setting jumper JP10 in terminal board ES801 (JP4010 in ES906) on pos. 1-2, the terminal will represent an output for a voltage signal, while when the jumper is set on pos. 2-3, the terminal will represent an output for a signal expressed in milliAmperes. An outgoing current only may be produced towards 0V potential. See also the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.	JP10 on pos. 1-2: -10 ... $+10V_{DC}$ 5mA max JP10 on pos. 2-3: 0 ... 20mA 10V max
11-13	**IN 1**: Analog input 1 (**11: IN 1+ / 13: IN 1-**) to be configured through parameter C120 (*AnIn1Cfg*). If both signal wires are connected, the two terminals represent a differential input with a high rejection to interferences. Alternatively, with a signal to be reflected to the drive 0V, the two terminals represent a common mode input. This common mode input is a non-reversing input if the signal "hot wire" is connected to terminal 11 when terminal 13 is disconnected, whereas it is a reversing input if it is connected to terminal 13 when terminal 11 is disconnected. By setting jumper JP8 in terminal board ES801 (JP408 in ES906) on pos. 2-3, the two terminals will represent an input for a signal expressed in Milliamperes: a positive reference is generated if the current enters terminal 11 and goes out through terminal 13. See also the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.	JP8 on pos. 1-2: -10 ... $+10V_{DC}$ R_{in} = 20kΩ JP8 on pos. 2-3: 20mA max R_{in} = 200Ω

TERM.	Description	I/O Ratings
12	**CH N**: Zero position pulse of the encoder.	-
14	**CH A**: Channel A of the encoder.	102.400kHz max
15	**+5V**: +5V mains supply voltage for the encoder. It is optoinsulated from the 0V signal of analog inputs.	$+5V_{DC}$ 160mA max
16	**CH B**: Channel B of the encoder.	102.400kHz max
17	**IN 2**: Analog input 2 to be configured through parameter C121(*AnIn2Cfg*).	-10 … $+10V_{DC}$ R_{in} = 20kΩ
18	**0V**: Zerovolt.	-
19	**IN 3**: Analog input 3 to be configured through parameter C122 (*AnIn3Cfg*).	-10 … $+10V_{DC}$ R_{in} = 20kW
20	**DT 25Vmax**: Input for a tacho when it does not exceed the absolute value equal to 25V. Polarity has to be a positive one with bridge A running (not in a regenerative state).	-25 … $+25V_{DC}$ R_{in} ≈ 5kΩ
21	**0V**: Zerovolt.	-
22	**DT 80Vmax**: Input for a tacho when it does not exceed the absolute value equal to 80V. Polarity has to be a positive one with bridge A running (not in a regenerative state).	-80 … $+80V_{DC}$ R_{in} ≈ 80kΩ
23	**DT 250Vmax**: Input for a tacho when it does not exceed the absolute value equal to 250V. Polarity has to be a positive one with bridge A running (not in a regenerative state).	-250 … $+250V_{DC}$ R_{in} ≈ 300kΩ
24	**ENABLE**: Drive operation command enabling. The signal is active when the terminal is short-circuited with +24V (terminal 40). The contact related to this terminal, shown in the SIGNAL CONNECTIONS diagram, consists of a NO auxiliary contact of contactor KM energizing the drive power section. **See Note (1)**.	I_{in} ≈ 9mA
25-27	**MDO 1**: Digital output 1 to be configured through parameter P170 (*MDO1Cfg*). Default configuration: *0:Drive OK*.	5A / $250V_{AC}$ 5A / $30V_{DC}$
26	**START**: Enabling of the speed / voltage references or current references to be found on analog inputs REF, IN 1, IN 2, IN 3 (summed up to the reference from serial connection, field bus and *UpDownRef* internal variable), or enabling of one of the run preset references. The signal is active when the terminal is short-circuited with +24V (terminal 40). When the contact on terminal 26 opens, a ramp down is set starting from the current speed / voltage signal. The ramp down time is set in parameter P034 or P035. See RAMPS OVER REFERENCE chapter for the inequality relations assuring that the times set for the stop ramps in par. P034 and P035 are exactly respected.	I_{in} ≈ 9mA
28	**MDI 1**: Digital input 1 to be configured through parameter C130 (*MDI1Cfg*). Default configuration: *0:Reset*.	I_{in} ≈ 9mA
29-31	**MDO 2**: Digital output 2 to be configured through parameter P176 (*MDO2Cfg*). Default configuration: *1:SpeedThreshold*.	5A / $250V_{AC}$ 5A / $30V_{DC}$
30	**MDI 2**: Digital input 2 to be configured through parameter C131 (*MDI2Cfg*). Default configuration: *12:JogA*.	I_{in} ≈ 9mA
32	**MDI 3**: Digital input 3 to be configured through parameter C132 (*MDI3Cfg*). Default configuration: *13:JogB*.	I_{in} ≈ 9mA
33-35	**MDO 3**: Digital output 3 to be configured through parameter P182 (*MDO3Cfg*). Default configuration: *2:Iarm Threshold*.	5A / $250V_{AC}$ 5A / $30V_{DC}$
34	**MDI 4**: Digital input 4 to be configured through parameter C133 (*MDI4Cfg*). Default configuration: *1:Preset Speed A*.	I_{in} ≈ 9mA

TERM.	Description	I/O Ratings
36	**MDI 5**: Digital input 5 to be configured through parameter C134 (*MDI5Cfg*). Default configuration: *4:Clim*.	Iin ≈ 9mA
37-39	**MDO 4**: Digital output 4 to be configured through parameter P188 (*MDO4Cfg*). Default configuration: *5:Drive Running*.	5A / 250V_{AC} 5A / 30V_{DC}
38	**MDI 6**: Digital input 6 to be configured through parameter C135 (*MDI6Cfg*). Default configuration: *5:Reverse*.	Iin ≈ 9mA
40	**+24V (OPTO)**: +24V main voltage supply output for digital inputs operation and/or to supply the encoder. It is optoinsulated from the 0V signal of analog inputs.	+24V_{DC} 200mA max
41-43	**MDO 5**: Digital output 5 to be configured through parameter P194 (*MDO5Cfg*). Default configuration: *4:CurrLimitation*.	5A / 250V_{AC} 5A / 30V_{DC}
42	**0V(OPTO)**: Negative terminal of +24V external supply voltage (if any) to supply the control section and/or the encoder. It is optoinsulated from the 0V signal of analog inputs. If the digital inputs come from the static outputs of a PLC, 0V of the PLC is to be connected to this terminal.	-
44	**+24V(EXT)**: Input for positive terminal of +24V external supply voltage to supply the control section.	+24V_{DC} / 2A max

(1) Note.

1a DRIVE LOCK WHILE STOPPING.

Suppose C051 is set at *1:Predictive=>J1* value. In that case, even after the *START* contact to terminal 26 is open and the motor fall ramp is over, if the *ENABLE* contact to terminal 24 is kept closed, the drive "regulates zero current" (no torque is generated), i.e. the drive is still operating, although the motor is idling.
While the motor is not running (idling), if for some particular reasons contactor KM has to remain closed for a long time, for the operator's safety it is possible to wire an **additional contact** to terminal 24; such contact is to be series connected to auxiliary contact NO of contactor KM. If this contact opens, the current reference will be set to zero, and the drive will be disabled (motor idling, drive in stand-by).
On the other hand, in case parameter C051 is set at *0:PI operating*, the drive will automatically inhibit any firing pulse as soon as the motor down ramp is over. The motor keeps idling.

1b MOTOR NEUTRAL

If a rotating motor controlled by the drive is to be put in neutral, the contactor is recommended not to be opened. First open the above-mentioned additional contact (which is to be previously wired to terminal 24, series connected to auxiliary NO contact of contactor KM), then open contactor KM.

1c CLOSING THE *ENABLE* CONTACT WHEN THE MOTOR IS IDLING.

When the connected motor is idling and the *ENABLE* contact is closed but the *START* contact is open, the system sets the ramp set for par. P034 (*RampStopPos*) or par. P035 (*RampStopNeg*) up to zero speed. The connected motor keeps idling.

3.30 LEDS AND TEST POINTS ON CONTROL BOARD

The following is a list of visual indications provided by the LEDs installed on control board ES800 (ES906). The voltage values of the test points on the same board are also stated.

LEDs:

OP1	(green)	S8	heatsink switch closed
OP5	(green)	SA	bridge A active
OP6	(yellow)	SB	bridge B active
OP7	(green)	RUN	drive running
OP8	(yellow)	LIM	drive in current limitation
OP27	(green)	S0	Terminal 24 connected to +24V OPTO (ENABLE)
OP28	(green)	S1	Terminal 26 connected to +24V OPTO (START)
OP29	(green)	S2	Terminal 28 connected to +24V OPTO (MDI1)
OP30	(green)	S3	Terminal 30 connected to +24V OPTO (MDI2)
OP31	(green)	S4	Terminal 32 connected to +24V OPTO (MDI3)
OP32	(green)	S5	Terminal 34 connected to +24V OPTO (MDI4)
OP33	(green)	S6	Terminal 36 connected to +24V OPTO (MDI5)
OP34	(green)	S7	Terminal 38 connected to +24V OPTO (MDI6)
OP35	(green)	SC	Contact at terminals 25-27 closed (MDO1)
OP36	(green)	SD	Contact at terminals 29-31 closed (MDO2)
OP37	(green)	SE	Contact at terminals 33-35 closed (MDO3)
OP38	(green)	SF	Contact at terminals 37-39 closed (MDO4)
OP39	(green)	SG	Contact at terminals 41-43 closed (MDO5)
OP40	(green)	STX	active serial transmission to keypad

TEST POINTS:

TS3	(dia 2.1)	GND	0V
TS6	(dia 1.2)	H0OUT	armature current (+2.5V at 100%)
TS8	(dia 1.2)	VAR	armature voltage (0V … +5.0V with –665V … +665V)
TS9	(dia 1.2)	VAC	mains voltage (+3.0V approx. with 380VAC)
TS36	(dia 2.1)	GND	0V
TS38	(dia 1.2)	AN0	tacho generator (±4.5V at 100%)
TS46	(dia 1.2)	CHB	channel B of encoder (digital signal 0-5V)
TS47	(dia 1.2)	CHA	channel A of encoder (digital signal 0-5V)
TS56	(dia 2.1)	GND	0V
TS59	(dia 1.2)	+5V	+5V digital (referred to GND)
TS60	(dia 1.2)	+5VOP	+5V optoinsulated for encoder (referred to OP)
TS61	(dia 1.2)	OP	0V reference for +5VOP and +A
TS62	(dia 1.2)	+A	+24V optoinsulated (referred to OP)

3.31 FEEDBACK FROM ENCODER

For the encoder connection, the following may be used:
1. The M1 screw double terminal board with 44 terminals.
2. The CN2 9-pole D-connector.

In both cases, all the available input channels and supply values are **optoinsulated** with respect to the analog inputs potential. When choosing the encoder type, check the **max. speed frequency**, that may be obtained from the following formula $f_{max} = \frac{pulses/rev \cdot n_{max}}{60}$, where *pulse/rev* is the encoder number of pulses for each complete rotation and n_{max} is the max. rotation speed expressed in rev/min.

Using the screw terminal board.
In the first event the features of the encoder to be connected are the following:
1a. Complementary *push-pull* encoder or NPN-type or *Open Collector*
2a. High level of the output waveform on the three channels equal to 24VDC max
3a. Input maximum frequency equal to 102.400kHz (e.g. 1024 pulse/rev for 6000 RPM max.)
4a. 5Vdc or 24Vdc voltage available for encoder supply through DCREG drive

The following terminals should be used:

14 - Input for channel A	15 - 5VDC supply output
16 - Input for channel B	42 - 0V
12 - Input for channel N (1)	40 - 24VDC supply output

The encoder screened cable shield should be connected to the ground potential as directly as possible. Use one of the 3 collar-shaped cable fasteners located on the bottom of the control board supporting guard.

Using the D-connector.
In the second case the features of the encoder to be connected are the following:
1a. *Line-driver* encoder (RS422 output standard)
2a. High level of the output waveform on the six channels ranging from 5...15Vdc
3a. Max. input frequency equal to 102.400kHz (e.g. 1024 pulse/rev for 6000 RPM max)
4a. 5Vdc or 24Vdc encoder supply through DCREG drive

The following D-connector pins should be used:

pin 1 - Input for channel *A*	pin 6 - Input for channel $\overline{N}$ (1)
pin 2 - Input for channel $\overline{A}$	pin 7 - 5VDC supply output
pin 3 - Input for channel *B*	pin 8 - 0V
pin 4 - Input for channel $\overline{B}$	pin 9 - 24VDC supply output
pin 5 - Input for channel *N* (1)	

In this case, it is not necessary to use one of the three collar-shaped cable fasteners located on the bottom of the control board supporting guard to connect the screened cable shield of the encoder to the ground potential, unless a screened 9-pole flying male connector is used. Said connector is to be assembled inside a screening metal body:
ITT-CANNON mod. DE121073-154 (connector body) + n.2 250-8501-013 (pair of long fastening screws).
FRAMATONE mod. 8655 MH 09 01.
In that way, the ground potential on 90° female connector in board ES801(ES906) will be transmitted to the metal body, then to the screened cable shield connecting the encoder.
The connector body is supplied by ELETTRONICA SANTERNO (code CN0420000), as well as 9-pole D-connector (code CN0400018).

(1) This is not required for the speed feedback, but is required for the position control.

3.32 MILLIAMPERE INPUT / OUTPUT SIGNALS

It is possible to feed an analog input as an mA signal to terminals 5 / 7 (*REF*) or terminals 11 / 13 (*IN 1*): if current enters terminal 5 and goes out from terminal 7, or if current enters terminal 11 and goes out from terminal 13, the internally generated signal is positive by default.
Similarly, it is possible to obtain an **analog output as an mA signal** from terminal 8 (*OUT 1*) or terminal 10 (*OUT 2*): said signal, that may be only outgoing towards 0V, is obtained by an internally generated signal which is positive by default.

1. INPUT SIGNALS

Between signal I_{in} in mA, which is externally applied, and signal V_{RL} in Volt, which is internally generated in the load resistance terminals, the following relation is applied:

$$I_{in} = 20mA \Rightarrow V_{RL} = 4V$$

The *Gain* and *Bias* functions (and the *Polarity* and *Reverse* following functions) may be applied to signal V_{RL} before generating the *TermRef* reference displayed by parameter M014 (or signal *AnIn1* displayed by parameter M010), according to the formula below:

$$TermRef(AnIn1) = V_{RL} \cdot \frac{Gain}{100} + 10 \cdot \frac{Bias}{100}$$

With the default values of the relevant parameters, the final matching between I_{in} and *TermRef*(*AnIn1*) is the following:

$I_{in} = 0mA \Rightarrow TermRef(AnIn1) = 0V$
$I_{in} = 4mA \Rightarrow TermRef(AnIn1) = 0.8V$
$I_{in} = 20mA \Rightarrow TermRef(AnIn1) = 4V$

The table below shows the values to be assigned to the different parameters relating to the *Gain* and *Bias* functions in order to obtain a given percentage of internal reference *TermRef(AnIn1)*, with 100% corresponding to 10V, starting from external signal I_{in} in mA. The table assumes that the parameters relating to the *Polarity function* (parameter P120 and P126) are at their default value and that the *Reverse function* is not applied.

I_{in} ⇒ M014 (M010)	Jumper **JP7** in ES801 (**JP407** in ES906) in **pos. 2-3**				Jumper **JP8** in ES801 (**JP408** in ES906) in **pos. 2-3**	
	REF [Terminals 5 / 7] Speed / voltage reference		***REF*** [Terminals 5 / 7] Armature current reference		***IN 1*** [Terminals 11 / 13]	
	Gain	***Bias***	***Gain***	***Bias***	***Gain***	***Bias***
0...20mA ⇒ 0...+100%	P122=250%	P121=0%	P125=250%	P124=0%	P128=250%	P127=0%
0...20mA ⇒ –100%...+100%	P122=500%	P121=–100%	P125=500%	P124=–100%	P128=500%	P127=–100%
4...20mA ⇒ 0...+100%	P122=312.5%	P121=–25%	P125=312.5%	P124=–25%	P128=312.5%	P127=–25%
4...20mA ⇒ –100%...+100%	P122=625%	P121=–150%	P125=625%	P124=–150%	P128=625%	P127=–150%

2. OUTPUT SIGNALS

Between signal *AnOut1*(2) in Volt, which is internally generated after configuring analog output *OUT 1* or *OUT 2* as desired and which is displayed by parameters M019 and M020 respectively, and outgoing signal I_{out} in mA, the following relation is to be applied:

$$AnOut1(2)=10V \Rightarrow I_{out}=20mA$$

Before generating signal *AnOut1*(2), the *Gain* and *Bias* functions may be used (followed by the *Polarity* function) starting from signals $V_{out1(2)}$ originally configured, according to the formula below:

$$AnOut = V_{out} \cdot \frac{Gain}{100} + 10 \cdot \frac{Bias}{100}$$

With the default values of the relevant parameters, the final matching between V_{out} and I_{out} is the following:

$V_{out} = 0V \Rightarrow I_{out} = 0mA$
$V_{out} = 2V \Rightarrow I_{out} = 4mA$
$V_{out} = 10V \Rightarrow I_{out} = 20mA$

The table below shows the values to be assigned to the different parameters relating to the *Gain* and *Bias* functions to obtain a particular signal I_{out} in mA, starting from internal signal V_{out} in Volt. The table assumes that the parameters relating to the *Polarity* function (par. P157 and P158) are at their default value.

$V_{out} \Rightarrow I_{out}$	Jumper **JP9** in ES801 (**JP409** in ES906) in **pos. 2-3**		Jumper **JP10** in ES801 (**JP4010** in ES906) in **pos. 2-3**	
	OUT 1 [Terminal 8]		***OUT 2*** [Terminal 10]	
	Gain	***Bias***	***Gain***	***Bias***
0 ... 10V ⇒ 0 ... 20mA	P152 = 100%	P151 = 0%	P155 = 100%	P154 = 0%
0 ... 10V ⇒ 4 ... 20mA	P152 = 80%	P151 = 20%	P155 = 80%	P154 = 20%
–10 ... +10V ⇒ 0 ... 20mA	P152 = 50%	P151 = 50%	P155 = 50%	P154 = 50%
–10 ... +10V ⇒ 4 ... 20mA	P152 = 40%	P151 = 60%	P155 = 40%	P154 = 60%

4 KEYPAD AND ALPHANUMERIC DISPLAY

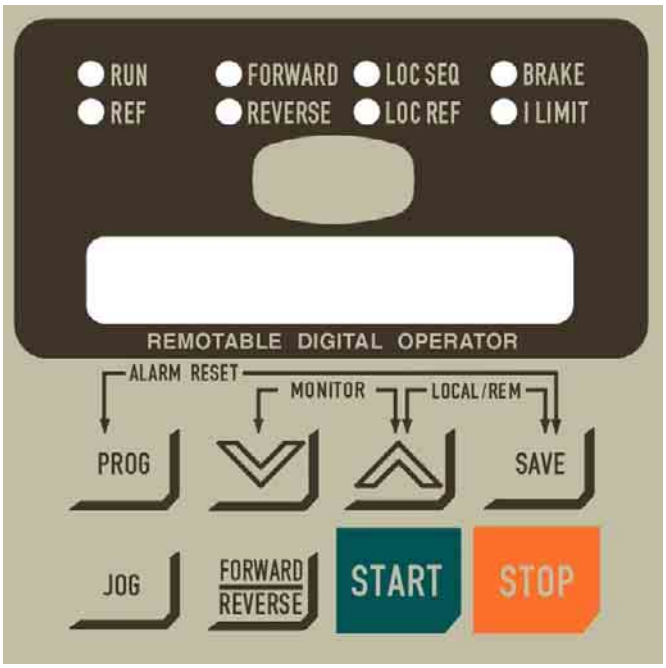
4.1 KEYS OPERATING MODALITIES

The drives of the DCREG2 and DCREG4 Series may be equipped with a remotable keypad provided with an alphanumeric display, including 8 keys and 8 signalling LEDs.

NOTE

The keypad is **not** series installed on the drive and is to be delivered separately. The **remotable keypad kit** is to be ordered for the keypad assembly on a separate panel: see the REMOTABLE KEYPAD chapter.

The 2-line 16-digit backlit LCD display installed in the keypad shows the parameter values, the diagnostic messages and the values of the quantities processed by the drive. From now on, the term "page" indicates the 32 characters that are simultaneously displayed.



The eight keys have the following functions:

- "**PROG**": allows to switch from display mode (fixed cursor) to programming mode (blinking cursor) and vice versa. So when the cursor is fixed, you may use the scrolling keys to display the different parameters in sequence. When the cursor is blinking, you may change the value of the current parameter.

- "∨" ("DEC"): allows to decrease either the page number or the value displayed inside the current page, depending on which mode you selected with the "PROG" key, i.e. depending on the cursor state.

- "∧" ("INC"): allows to increase either the page number or the value displayed inside the current page, depending on which mode you selected with the "PROG" key, i.e. depending on the cursor state.

- "**SAVE**": in programming mode only, it saves the current value on the page displayed on non-volatile memory work area (EEPROM), so that the value is kept stored even after turning the drive off and is displayed at next power on.

- "**JOG**": is active only when at least one of the sources selected for the commands corresponds to *KeyPad,* and when depressed, it enables the jog mode with a reference equal to the one obtained by enabling digital input *JogA*.

- "$\frac{\textbf{FORWARD}}{\textbf{REVERSE}}$": is active only when at least one of the sources selected for the commands corresponds to *KeyPad*, and when depressed, it enables the polarity reversal of the *Ref n* reference applied to the ramps.

- "**START**": is active only when at least one of the sources selected for the commands corresponds to *KeyPad*, and when depressed, it enables a self-retained run command, with a reference equal to the one obtained by enabling the *START* digital input. For the interaction of this key with the *START* digital inputs coming from other sources, refer to the *Ref n* section in the BLOCK DIAGRAM chapter.

- "**STOP**": in general, it is active only when at least one of the sources selected for the commands corresponds to *KeyPad*, and when depressed, it enables a stop command, just as if digital input *START* was disabled. For the interaction of this key with the *START* digital inputs coming from other sources, refer to the *Ref n* section in the BLOCK DIAGRAM chapter. In addition, even though none of the sources selected for the commands corresponds to *KeyPad*, this key may have the *STOP* function by setting par. C103 (*EmergStop*) to *0:Included*.

NOTE

When operating, the drive uses the current parameter set, i.e. the parameters available at the moment. The parameter that has been updated with the "∨" and "∧" keys will be immediately used instead of the previous parameter, even if it is not saved with the "SAVE" key. The new value will not obviously be stored when the drive is turned off.

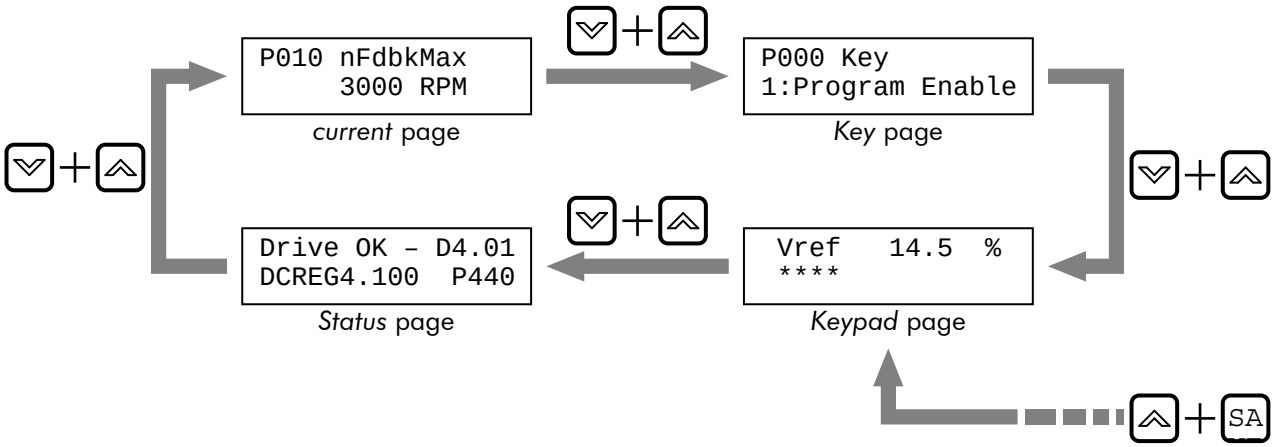
For a simpler use of the drive, the following command shortcuts are available:

- ALARM RESET: **Press the "PROG" and "SAVE" keys simultaneously** to close a digital input configured as *0:Reset* for an alarm reset. Of course, the alarm will be cancelled once the cause responsible for its trip has disappeared.

- QUICK PAGE SHIFT (*MONITOR* function): **Press the "∨" and "∧" keys simultaneously** to access the page relating to parameter P000 (*Key*). Press "∨" and "∧" again to access the *Keypad* page relating to parameter M000 (*Vref*) and to other measure parameters selected through parameter P005 (*FirstParm*) and P006 (*MeasureSel*). Press "∨" and "∧" for the third time to display the *Status* page. By pressing both keys once again, the operator may return to the page where the prior keys had been pressed.

- LOCAL MODE SWITCHING for commands and references : **Press the "∧" and "SAVE" keys simultaneously** to switch to LOCAL mode for the drive commands (digital inputs) and references. Switching is enabled only when parameter C100 (*LocRemSel*) is set at value *0:Enabled* with the drive disabled, i.e. not running. Whenever the drive is turned on, it will directly switch to the operating mode previously saved on EEPROM. Therefore, the LOCAL mode "status" enabled by pressing the "∧" and "SAVE" keys is not included among the variables that can be saved on EEPROM.

The diagram below shows the sequence of the pages displayed through the *MONITOR* function (the "∨" and "∧" keys are simultaneously pressed). For a better understanding, let us suppose to start from the page relating to par. P010 (*nFdkMax*) – the *current* page in the diagram. The diagram also shows that the *Keypad* page is also displayed by simultaneously pressing the "∧" and "SAVE" keys (**LOCAL** mode only, as explained in the LOCAL MODE OPERATION chapter).



4.2 FUNCTIONS DISPLAYED BY THE LEDS

The eight LEDs located on the alphanumeric display have the following functions:

- The ***RUN*** LED is on when the drive is *running* (i.e. when the firing board sends pulses). This LED blinks during the fall ramp programmed in parameters P034 (*RampStopPos*) or P035 (*RampStopNeg*) after disabling the START digital input. When this LED is on, the *RUN* LED in control board ES800 (ES906) is on as well.

- The ***REF*** LED may have the following two functions:
a) If at least one reference among *ref n* reference applied to the ramps and one of the three auxiliary references *IN 1, IN 2, IN 3* is configured as a speed reference, then the LED will turn on when the speed reference is other than zero, even when the motor is not started.
b) If no reference among *ref n* reference applied to the ramps and the three auxiliary references *IN 1, IN 2, IN 3* is configured as a speed reference, but at least one of them is configured as a current reference, then the LED will turn on when the current reference is other than zero even if the motor is not started.

- The ***FORWARD*** and ***REVERSE*** LEDs indicate the direction of rotation of the motor when it is on; the forward direction is the one obtained by generating a motor torque with a positive reference. When the motor is not yet running, the *FORWARD* LED will flash if the prepared run reference has a positive polarity, whereas the *REVERSE* LED will flash if the prepared run reference has a negative polarity.

WARNING the reference polarity indication supplied by LEDs *REF, FORWARD* and *REVERSE* when the drive is not yet running, **do not** consider any additional speed or current references.

- The ***LOC SEQ*** LED is on if the sources selected for the commands are *KeyPad*-related, it flashes if another source different than *KeyPad* is selected, while it is off if none of the sources selected for the commands is *KeyPad*-related.

- The ***LOC REF*** LED is on if the sources selected for the references are *UpDownRef*-related only, it flashes if another source different than *UpDownRef* is selected, while it is off if none of the sources selected for the references is *UpDownRef*-related.

- The ***BRAKE*** LED indicates that the electrical braking, or in general the energy regeneration from the load to the mains, is on.

- The ***I LIMIT*** LED indicates that the drive is in current limit. When this LED is on, *ILIM* LED in control board ES800 (ES906) is on as well.

4.3 LOCAL OPERATING MODE

As we stated above, the *Main Ref* can result from the sum of max. **four** sources:
1. Terminals (*Terminal Ref*)
2. Up / Down internal reference (*UpDown Ref*)
3. Serial connection (*Serial Link Ref*)
4. Field bus (*Field Bus Ref*)

Similarly, the command sequences (digital inputs) can be simultaneously entered through **three** sources selected among the four available sources:
1. Terminals (Terminal Digital Input)
2. Keypad (KeyPad)
3. Serial connection (Serial Link Digital Input)
4. Field bus (Field Bus Digital Input)

MIXED mode: whenever the drive is turned on, the active operating mode depends on the values stored on EEPROM for parameters C105 ... C108 (*RefSelx*) and parameters C110 ... C112 (*SeqSelx*). The active mode may be inferred by the state of LEDs *LOC REF* and *LOC SEQ*. Therefore, *Main Ref* can result from the sum of all four available sources, whereas the command sequence (digital inputs) can be simultaneously entered through max. three of the four sources.

LOCAL mode only: if the "∧" and "SAVE" keys are simultaneously pressed - if par. C100 (*LocRemSel*) is set at *0:Enabled* - the drive will operate in LOCAL mode only for references and commands (i.e. digital inputs). Therefore, only one selected source is available for the reference, equal to *UpDownRef*, and only one source available for the commands equal to *KeyPad* will be simultaneously selected. In this way, the run / stop commands may be set only through keypad by pressing the "START" and "STOP" keys. In addition, the jog run may be set only by means of the "JOG" key, according to the reference value equal to the one obtained by enabling digital input *JogA*. The polarity reversal of the *Ref n* reference applied to the ramps may be obtained by pressing the

„ **FORWARD** „
REVERSE

key only.
When this mode is programmed, the display will automatically show the *KeyPad* page, relevant to par. M000 (*Vref*) and to other parameters selected through par. P005 (*FirstParm*) and P006 (*MeasureSel*). The programming mode is already active (as if par. P000 were set at *1:Program Enable*). This means that the *UpDownRef* reference value can be changed by pressing the increment and decrement keys. When the *KeyPad* page is displayed, the programming mode is always active, even though the operating mode is not the LOCAL mode only. If no source is selected for the *UpDownRef* reference, the *KeyPad* page allows to read the prepared reference only. When the "∧" and "SAVE" keys are pressed again, current values for parameters C105 ... C108 (*RefSelx*) and parameters C110 ... C112 (*SeqSelx*) will be reset.

4.4 KEYPAD REMOTE CONTROL

The keypad remote control kit includes the following:
1. N.1 panel-front frame.
2. N.1 stick-on rubber gasket.
3. N.1 RJ45 extension cord (L = 5m).
4. N.4 M3 self-locking nuts.
5. N.4 M3 flat washers.

To remove the keypad from the drive and to install it on a control panel front, follow the instructions below.
If the keypad is not installed on the equipment (standard supply), ignore steps c, d, e.

WARNING **Before following the instructions below, turn off the equipment to avoid damaging it.**

A. Loosen the flat-head screw fastening the keypad covering frame.
B. Remove the panel (with the screw still in).

A

B

C. Insert a screwdriver in the hole for the release of connector RJ45, which is connected to the keypad (see instructions on the keypad label).
D. Keep the screwdriver pressed (so that the retaining tab of connector RJ45 is unfastened) and extract the keypad.

C

D

E. The keypad is removed.
F. Extract the wire by pressing on the connector tab.

E

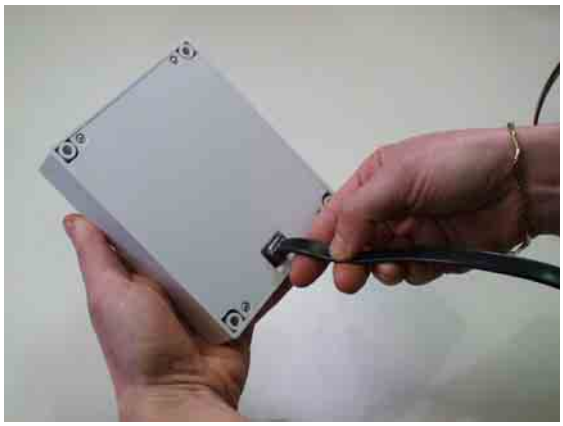
F

G. Insert the keypad frame again. Fasten with the proper screw.
H. Connect an end of the keypad extension cord to the connector installed on the DCREG.

G

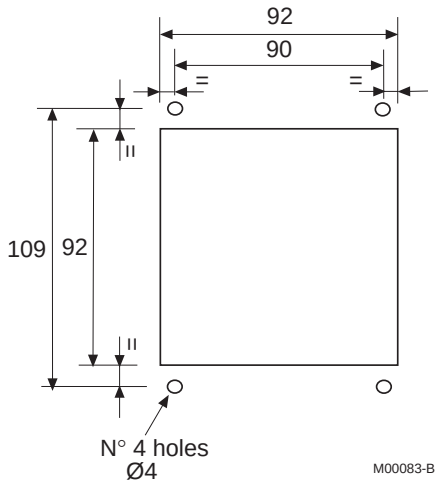
H

I. Insert the other end of the cord in the connector installed on the keypad rear part.
J. Remove the film from the stick-on label and apply it on the keypad front part.

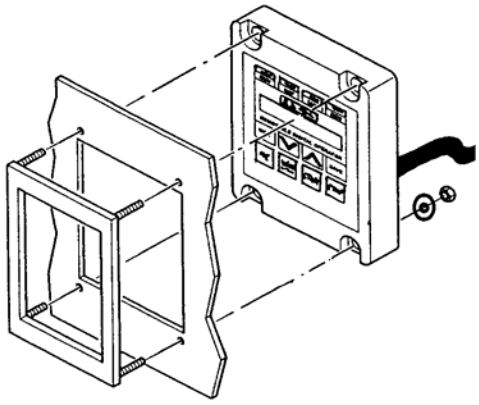

I

J

K. Make the panel holes for the frame assembly.
L. Fasten the keypad using the nuts and flat washers supplied with the kit.



K



L

5 FIRMWARE STRUCTURE

5.1 GENERAL

The drive control firmware is to be found in FLASH U20 of control board ES800 (ES906); its software version (Dx.xx) is displayed by the *Status* page, whereas the user's parameters may be saved on EEPROM U11 in the same board. Both components are located beneath the metal support of the keypad. EEPROM U11 is assembled on a 4+4 pin socket to be easily removed when required.

The software version installed may also be read on the two seven-segment displays installed on control board ES800 (ES906) by pressing the *PRO* key on the board located beneath the two displays. For instance, digit *36* stands for software version D3.06.
The parameter storage on EEPROM U11 may be checked - when the machine is not running - by pressing the *CPU RESET* key for a while (said key is to be found on control board ES800 (ES906) beside the *PRO* key) which is equivalent to temporarily switching off the control board.

WARNING **Never press the *CPU RESET* key if the machine is running.**

The user may interact with the parameters contained in the "M", "P", "C", "A" and "W" menus.

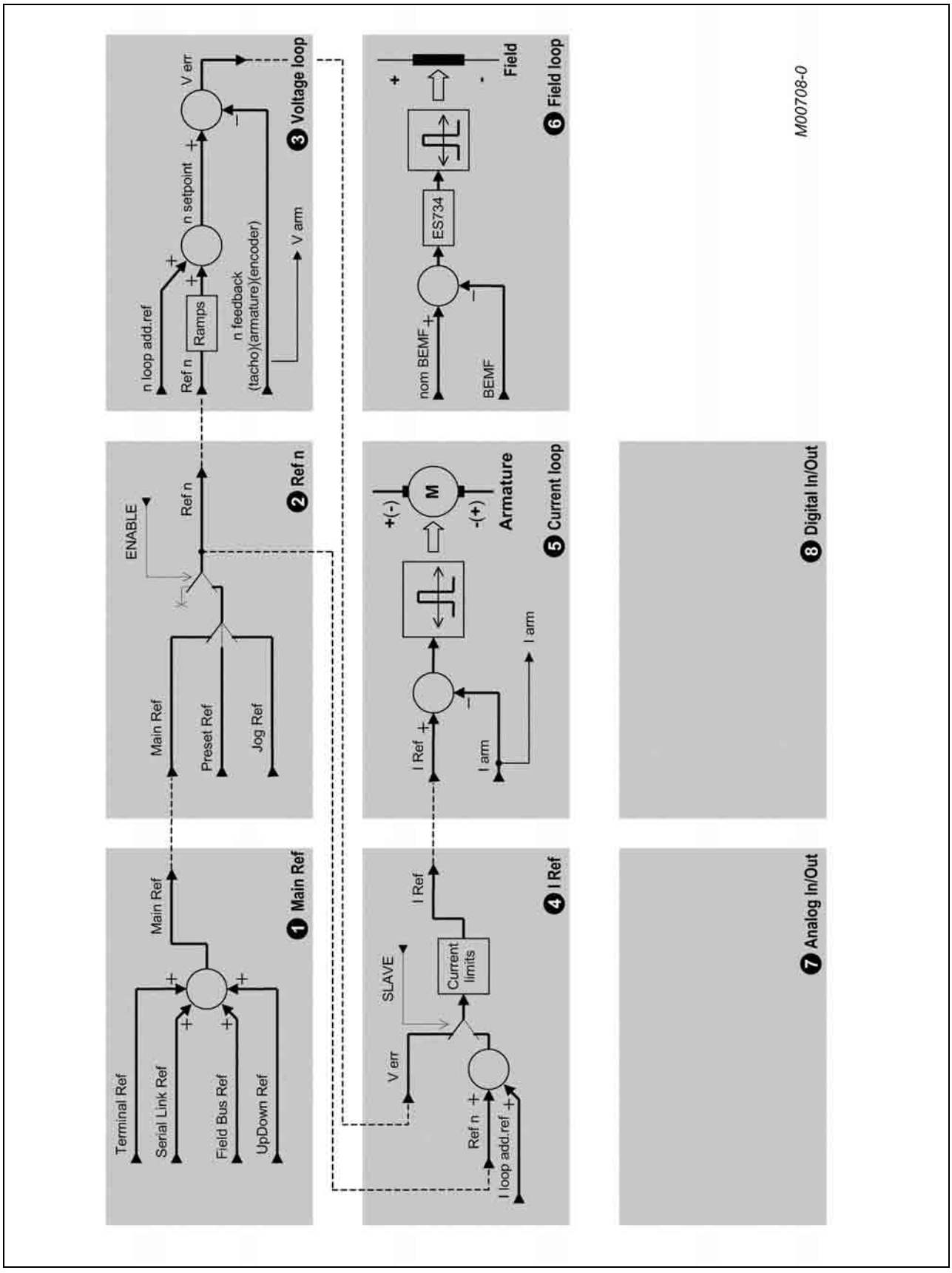
Mxxx parameters are read-only parameters; the user cannot interact with them.

Parameter P000 is the key-parameter containing the access codes allowing to modify any other *Pxxx* and *Cxxx* parameters. *Cxxx* parameters, unlike *Pxxx* parameters, may be changed only when the *ENABLE* digital input is not active. All said parameters allow the system to be completely configured; some of them are changed during the auto tuning stages.

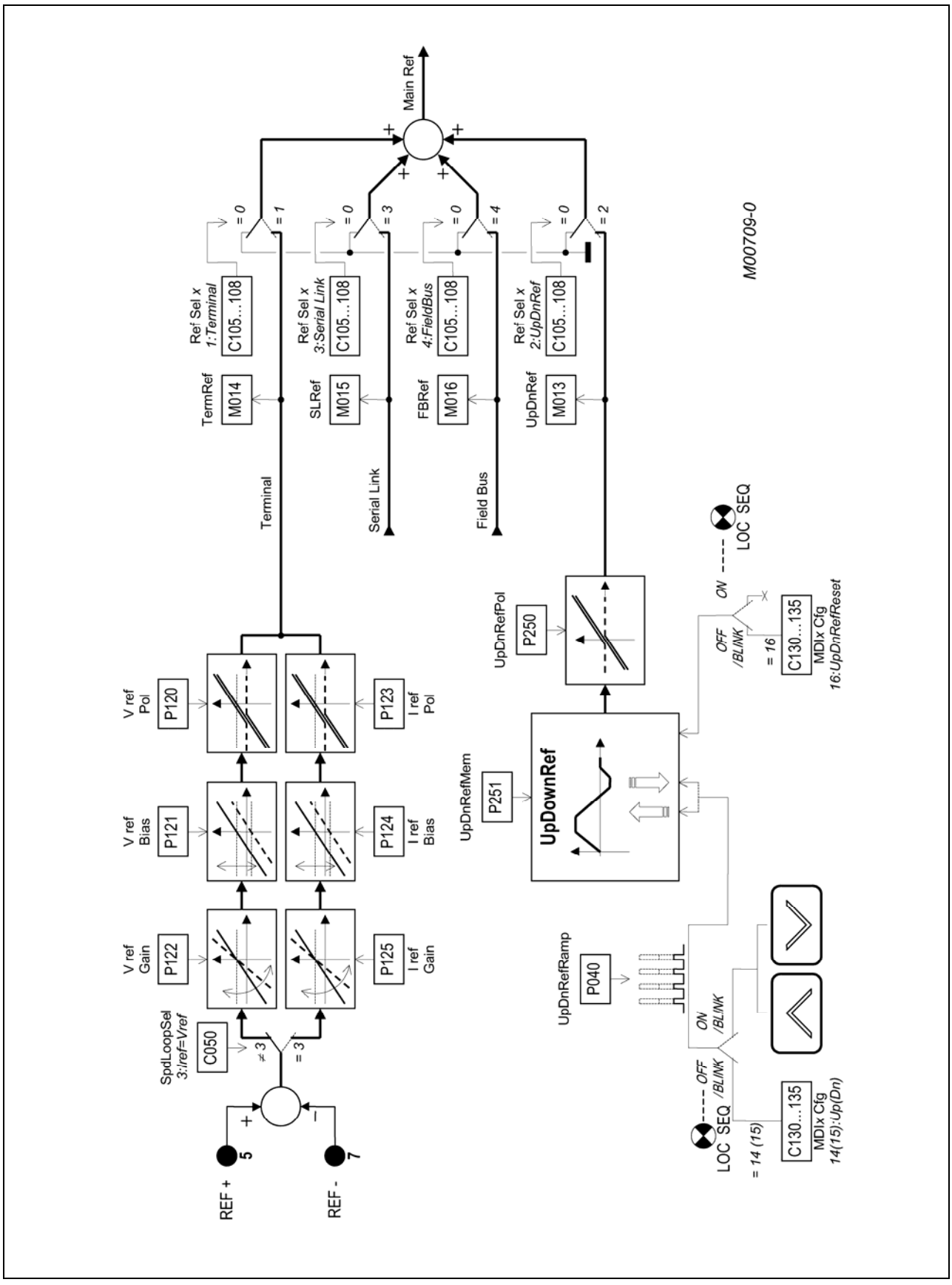
Also *Axxx* parameters are read-only parameters; they are displayed when an alarm trip is stored. The last two digits related to the alarm tripped will **blink** and will be displayed on the two 7-segment displays assembled on control board ES800 (ES906).

Also *Wxxx* parameters are read-only parameters. They contain some warning messages that do not imply the drive lock - unlike the alarm messages above. The last two digits of the alarm tripped will remain **fixed** and will be displayed on the two 7-segment displays assembled on control board ES800 (ES906).

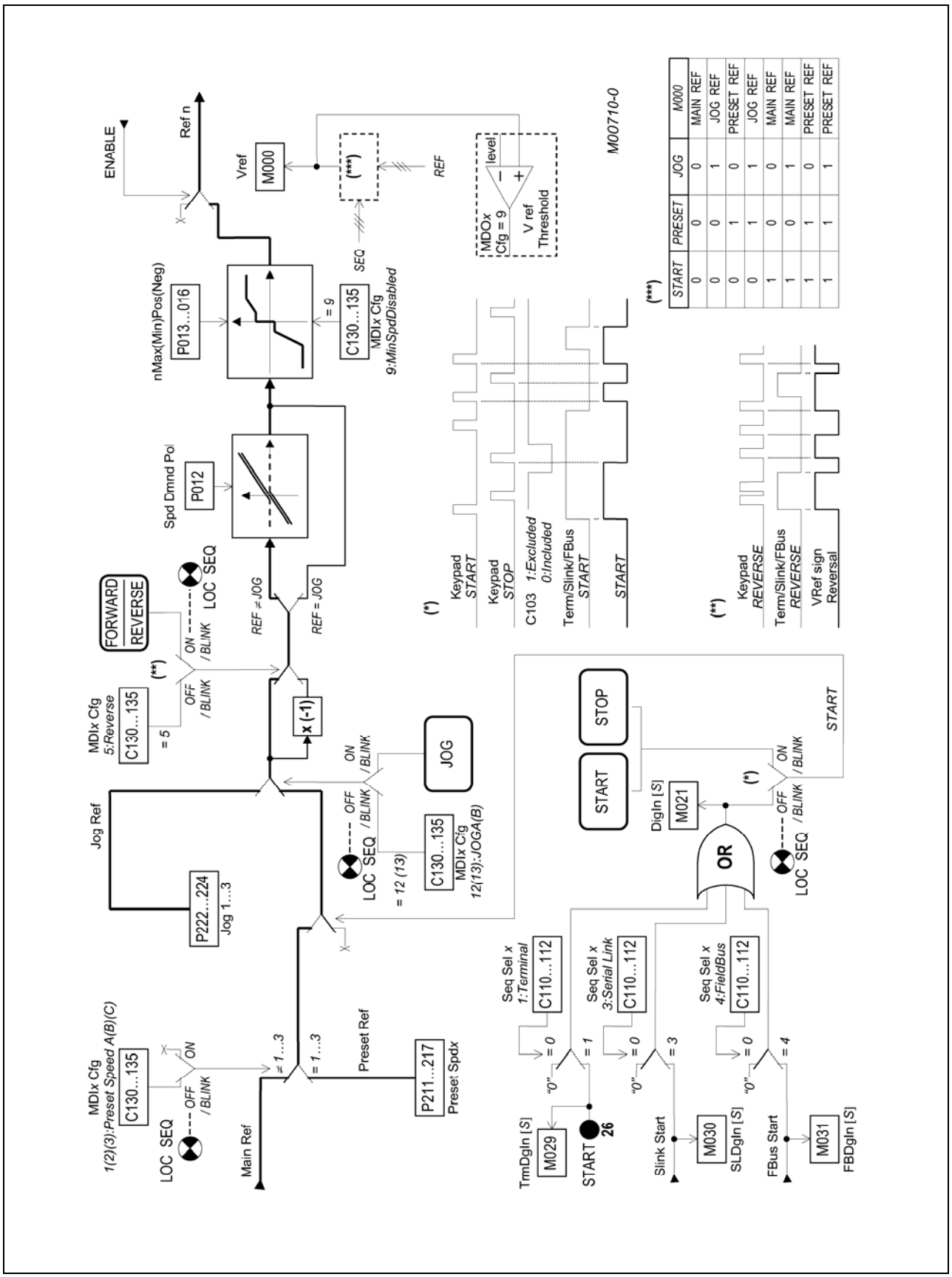
5.2 BLOCK DIAGRAM



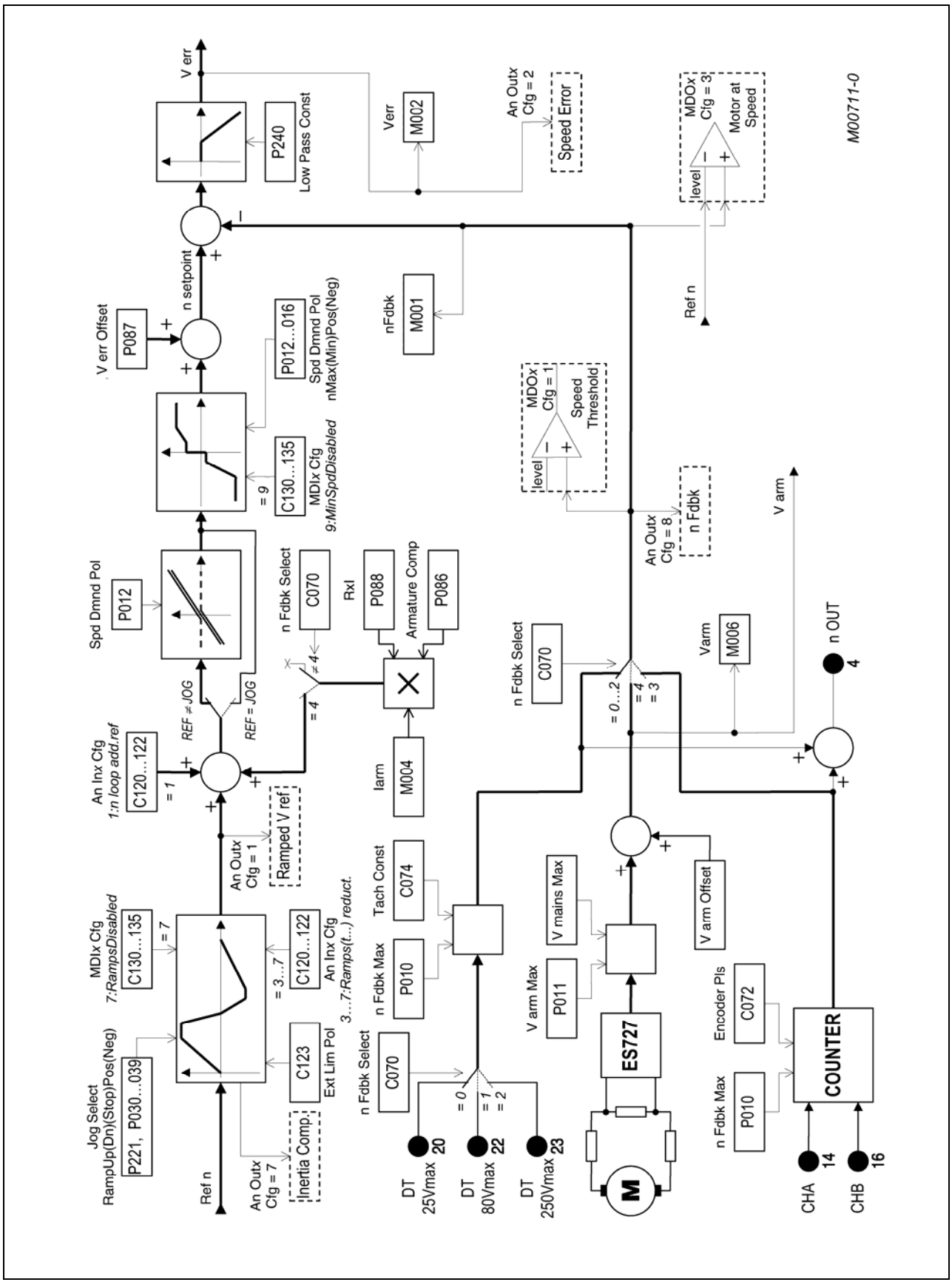
1 - Main Ref


Main Ref
Ref Sel x 1:Terminal
C105...108
Ref Sel x 3:Serial Link
Ref Sel x 4:FieldBus
Ref Sel x 2:UpDnRef
TermRef
M014
SLRef
M015
FBRef
M016
UpDnRef
M013
Terminal
Serial Link
Field Bus
M00709-0
V ref Pol
P120
V ref Bias
P121
V ref Gain
P122
I ref Pol
P123
I ref Bias
P124
I ref Gain
P125
SpdLoopSel 3:Iref=Vref
C050
REF +
REF -
UpDnRefPol
P250
UpDnRefMem
P251
UpDownRef
UpDnRefRamp
P040
LOC SEQ
ON
OFF
/BLINK
C130...135
MDIx Cfg
16:UpDnRefReset
14(15):Up(Dn)

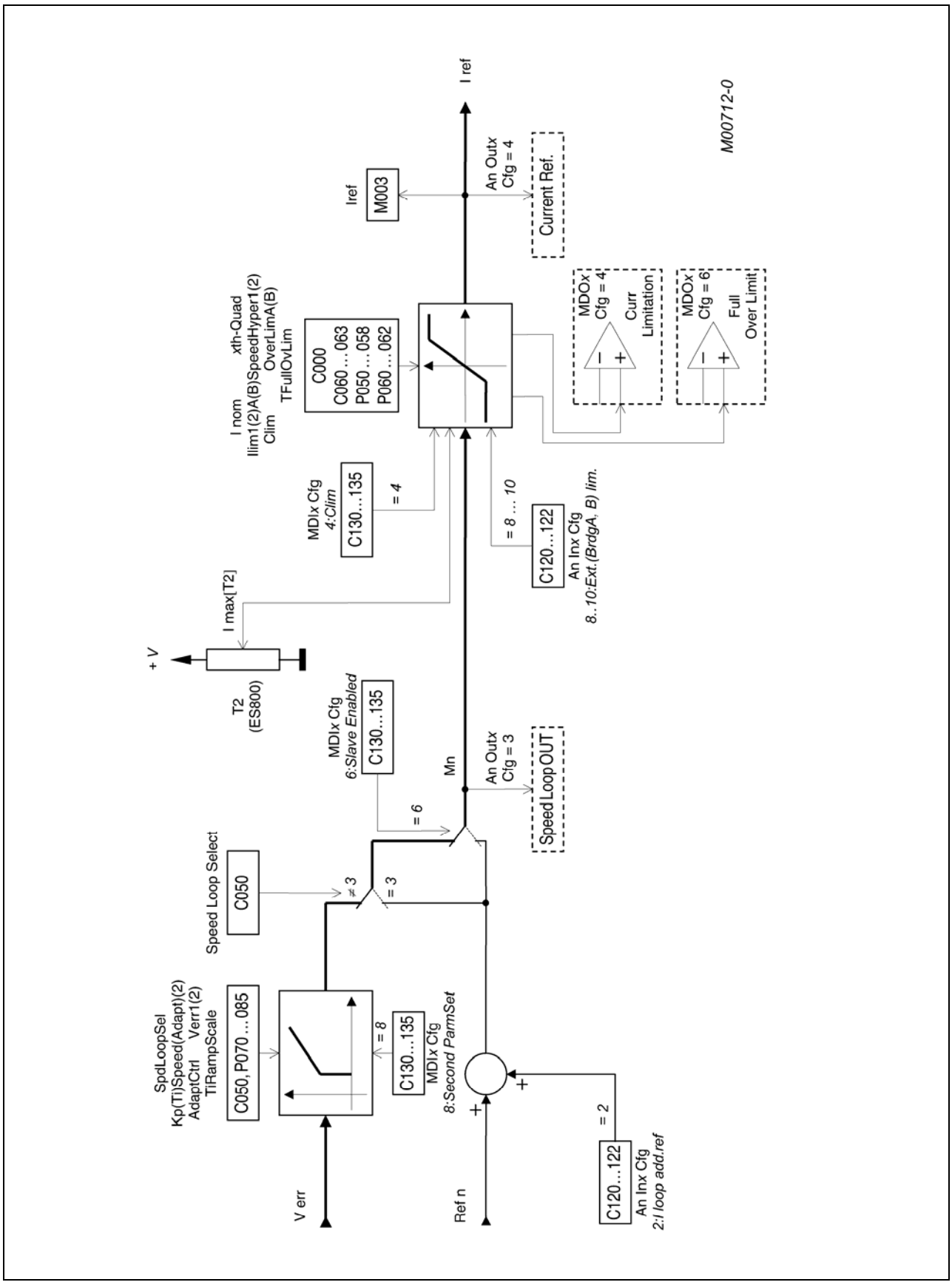
2 - Ref n


ENABLE
Ref n
Vref
M000
(***)
REF
SEQ
MDOx Cfg = 9
level
V ref Threshold
M00710-0
nMax(Min)Pos(Neg)
P013...016
C130...135
MDIx Cfg
9:MinSpdDisabled
= 9
Spd Dmnd Poi
P012
FORWARD
REVERSE
LOC SEQ
ON / BLINK
OFF / BLINK
REF ≠ JOG
REF = JOG
(**)
MDIx Cfg
5:Reverse
= 5
x (-1)
(*)
Keypad START
Keypad STOP
C103 1:Excluded 0:Included
Term/Slink/FBus START
START
(***)
START
PRESET
JOG
M000
MAIN REF
JOG REF
PRESET REF
Keypad REVERSE
Term/Slink/FBus REVERSE
VRef sign Reversal
Jog Ref
P222...224
Jog 1...3
MDIx Cfg
12(13):JOGA(B)
= 12 (13)
JOG
STOP
DigIn [S]
M021
OR
MDIx Cfg
1(2)(3):Preset Speed A(B)(C)
C130...135
≠ 1...3
= 1...3
Preset Ref
P211...217
Preset Spdx
Main Ref
Seq Sel x
1:Terminal
3:Serial Link
4:FieldBus
C110...112
= 0
= 1
= 3
= 4
"0"
TrmDgIn [S]
M029
START
26
Slink Start
M030
SLDgIn [S]
FBus Start
M031
FBDgIn [S]

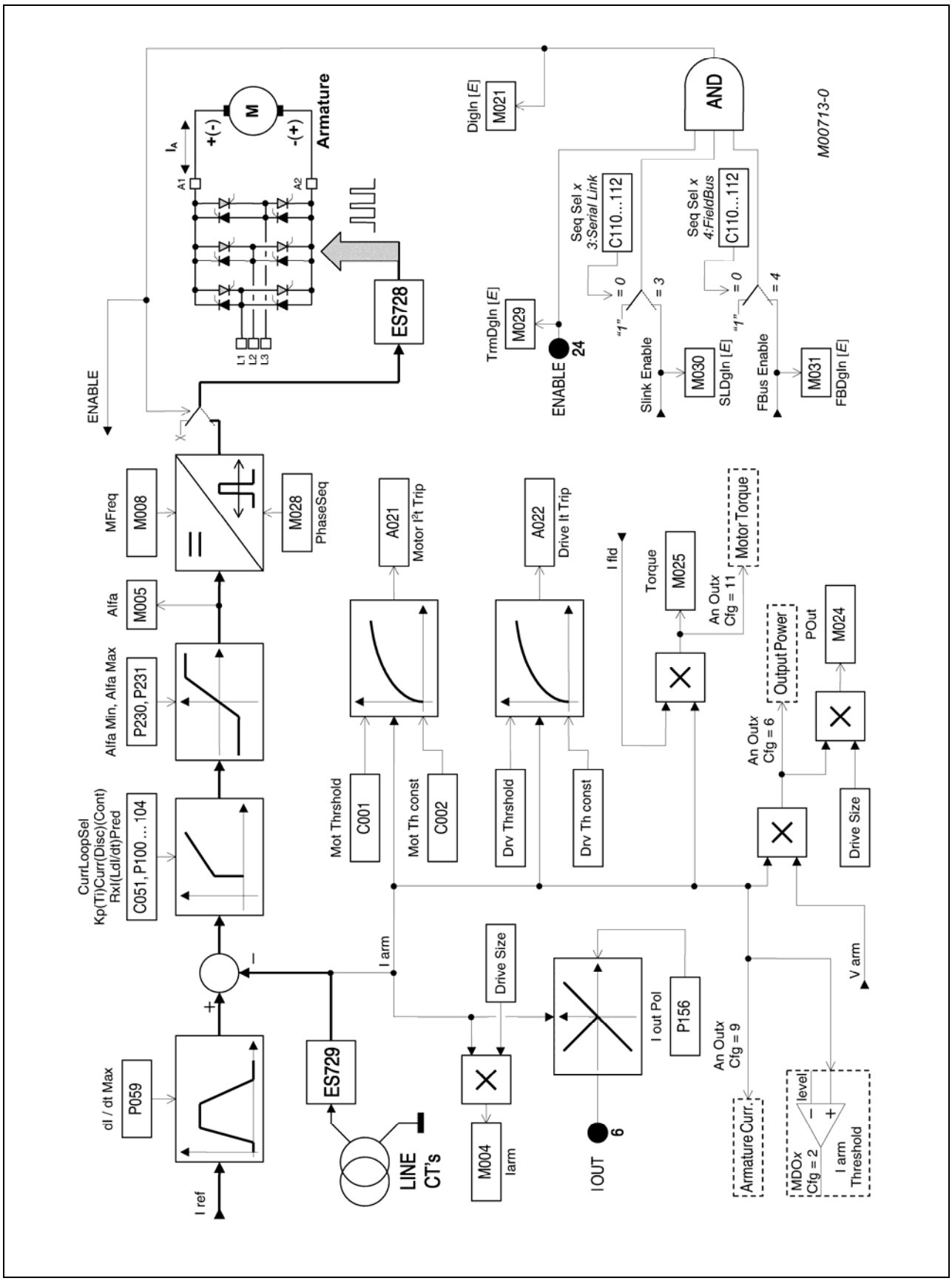
3 - Voltage loop



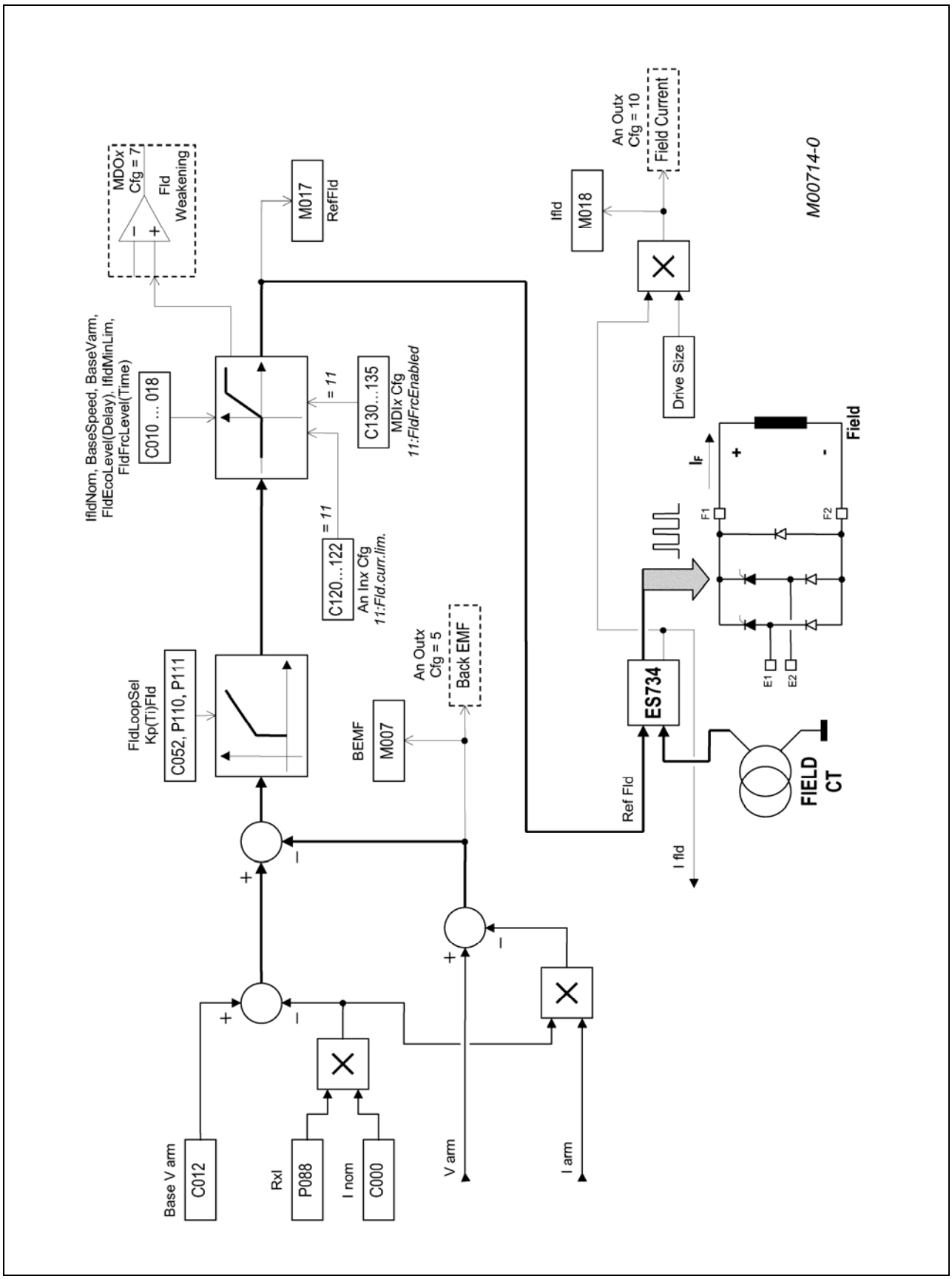
4- I Ref


I ref
M00712-0
Iref
M003
An Outx
Cfg = 4
Current Ref.
MDOx
Cfg = 4
Curr
Limitation
MDOx
Cfg = 6
Full
Over Limit
I nom
Ilim1(2)A(B)
Clim
xth-Quad
SpeedHyper1(2)
OverLimA(B)
TFullOvLim
C000
C060 ... 063
P050 ... 058
P060 ... 062
MDIx Cfg
4:Clim
C130...135
= 4
= 8 ... 10
C120...122
An Inx Cfg
8..10:Ext.(BrdgA, B) lim.
I max[T2]
+ V
T2
(ES800)
MDIx Cfg
6:Slave Enabled
C130...135
= 6
Mn
An Outx
Cfg = 3
SpeedLoopOUT
Speed Loop Select
C050
≠ 3
= 3
SpdLoopSel
Kp(Ti)Speed(Adapt)(2)
AdaptCtrl Verr1(2)
TiRampScale
C050, P070 ... 085
= 8
C130...135
MDIx Cfg
8:Second ParmSet
V err
Ref n
+
+
= 2
C120...122
An Inx Cfg
2:I loop add.ref

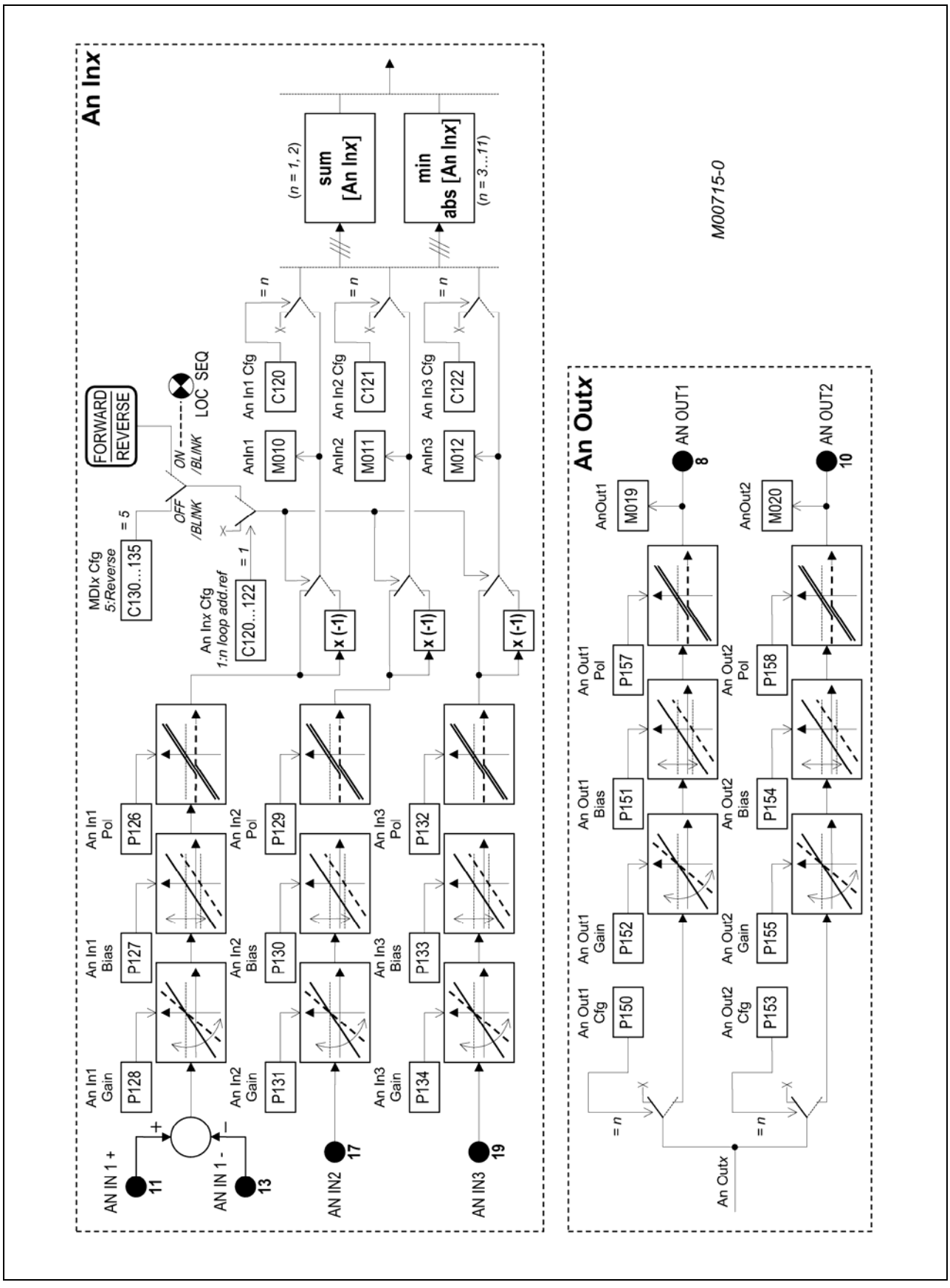
5 - Current loop



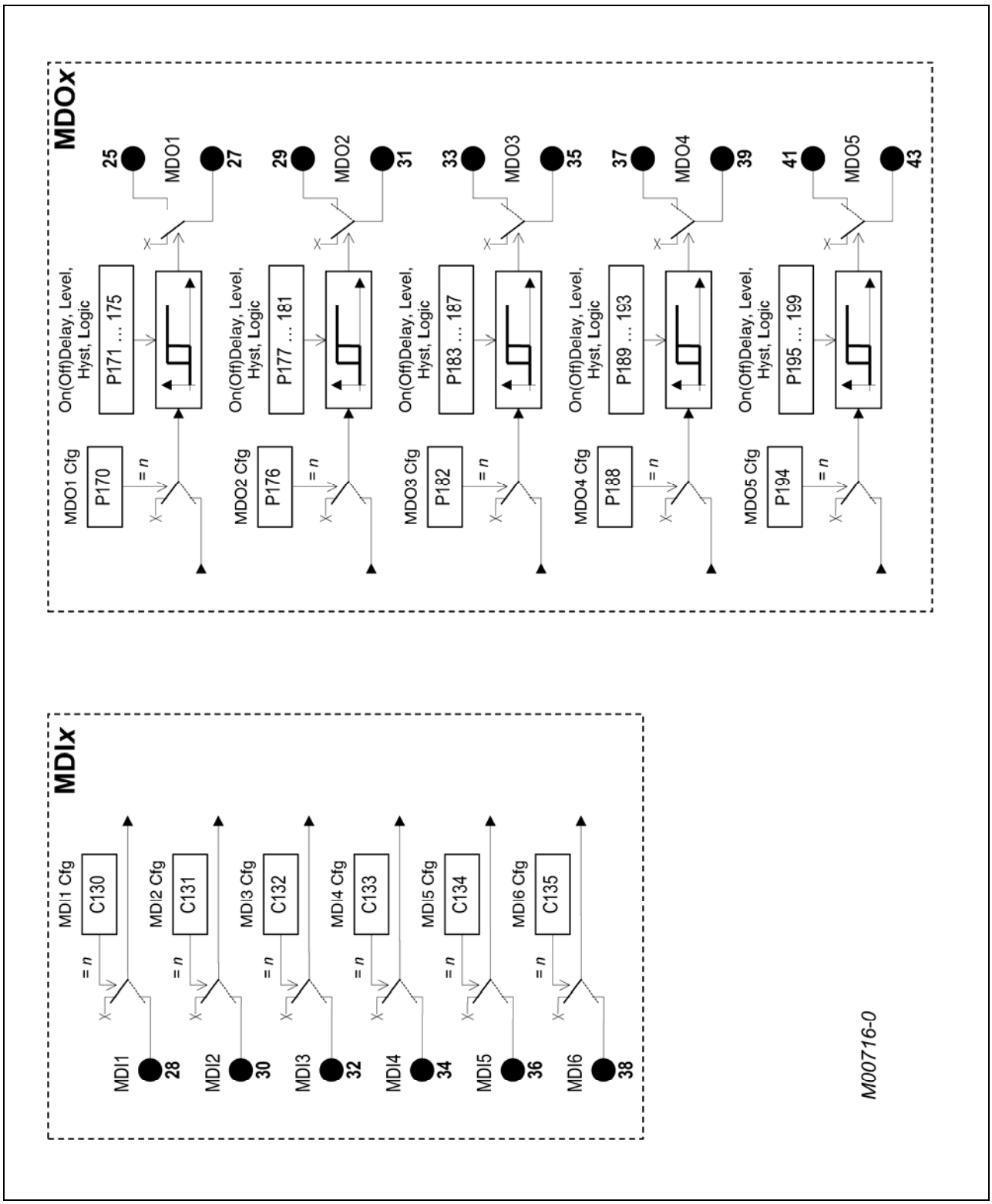
6 - Field loop


M00714-0
MDOx
Cfg = 7
Fld
Weakening
M017
RefFld
An Outx
Cfg = 10
Field Current
Ifld
M018
IfldNom, BaseSpeed, BaseVarm,
FldEcoLevel(Delay), IfldMinLim,
FldFrcLevel(Time)
C010 ... 018
= 11
C130...135
MDIx Cfg
11:FldFrcEnabled
Drive Size
Field
IF
F1
F2
E1
E2
= 11
C120...122
An Inx Cfg
11:Fld.curr.lim.
An Outx
Cfg = 5
Back EMF
FldLoopSel
Kp(Ti)Fld
C052, P110, P111
BEMF
M007
ES734
Ref Fld
FIELD
CT
I fld
Base V arm
C012
RxI
P088
I nom
C000
V arm
I arm

7 - Analog In/Out



8 - Digital In/Out

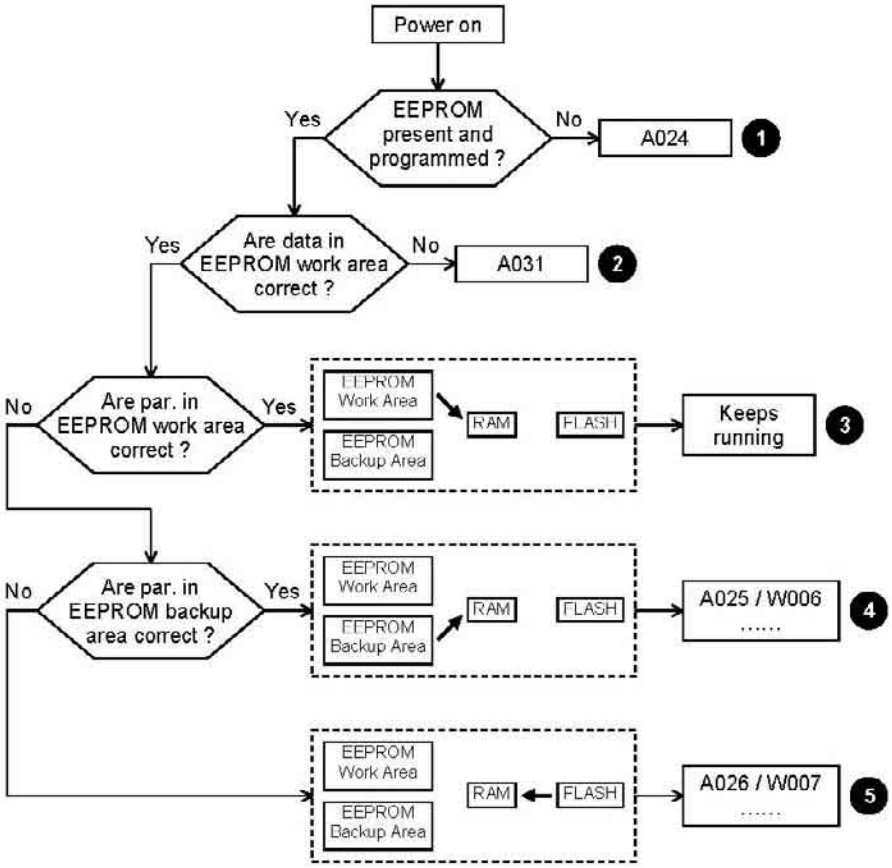


5.3 PARAMETER COPY

The parameters defined by the firmware can be written and read by the four memory areas of control board ES800 (ES906):

a. Flash U20, containing the default factory setting of all parameters.
b. RAM U21, containing the parameters used when the drive is on.
c. Work area of EEPROM U11, where the user parameters may be stored.
d. Backup area of EEPROM U11, where the user parameters may be copied for safety reasons.

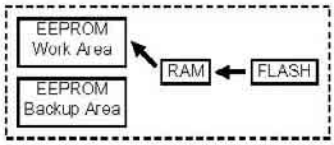
We adopted any measure (namely the serial communication for EEPROM U11) to prevent the values stored for the different parameters from being changed due to disturbance or transients. At the same time, a set of alarms and warnings will trip and suggest the reader how to retrieve the correct data.
The diagram below contains the sequence of the automatic controls performed when the equipment is turned on.



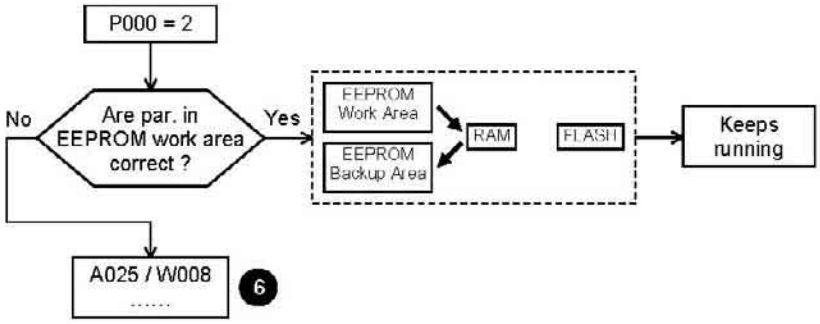
Step **3** typically takes place when the drive is turned on. In steps **4** and **5**, the parameter original values may be retrieved following the given instructions. For steps **1** and **2**, contact ELETTRONICA SANTERNO.
For a better understanding of the meaning of the different alarms or warnings, please refer to ALARM PARAMETERS and WARNING PARAMETERS chapters.

The parameters may be copied by the user as follows.

1. **Default parameter restoration**. To restore the default parameters, set par.P002 (*ParmsCopy*) at *1:DefaultRestore* and press the "SAVE" key twice. The user's customized parameters are erased, and the factory settings for parameters *Pxxx* and *Cxxx* will be reset in EEPROM work area (except the internal data, that cannot be accessed by the user).

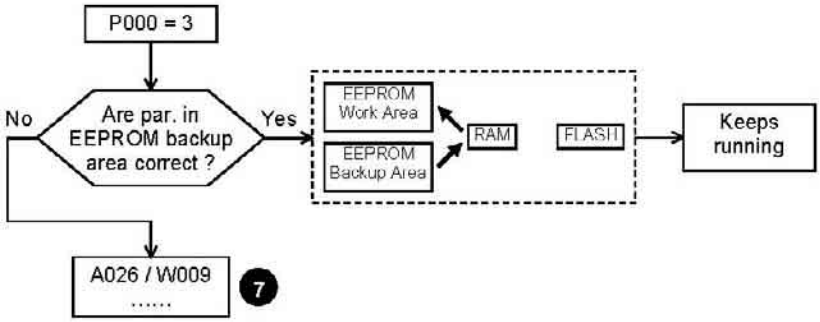


2. **Backup of the stored parameters**. To back up the stored parameters, set par. P002 (*ParmsCopy*) at *2:WorkAreaBackup* and press the "SAVE" key twice. The values stored in the EEPROM work area will be transferred to the RAM and will be copied on the EEPROM backup area. Before doing this, the equipment checks the data contained in the EEPROM work area. We strongly recommend to perform this backup once the equipment is started, when all changes made to those parameters are stored in the EEPROM work area and written in the special table to be found in the last pages of this manual.



In step **6**, the parameter original values may be retrieved following the given instructions.

3. **Backup parameter restoration**. To restore the backup parameters, set par. P002 (*ParmsCopy*) at *3:Backup Restore* and press the "SAVE" key twice. The parameters stored in the EEPROM backup area will be restored in the RAM and in the EEPROM work area, even if new values had been stored. Before doing this, the equipment checks the data contained in the EEPROM backup area.



In step **7**, the parameter original values may be retrieved following the given instructions.

6 SPECIAL FEATURES

6.1 AUTOMATIC TUNING

The drives of the DCREG2 and DCREG4 series are provided with a particular operating mode, which is able to recognize the essential characteristics of the motor and load as well, in order to automatically calculate the optimal parameters to be inserted into the current and speed loops.

The different parameters containing the above mentioned characteristics do already have default values written in the EEPROM, which normally grant a generally satisfactory operation for the most common applications of the drive. To better streamline the performances, the AUTOMATIC TUNING procedure can be performed. This display-assisted procedure is performed off-line at the first set-up of the machine and whenever necessary (i.e., if the electromechanical characteristics of the machine have changed).
For instance, the following sections refer to the digital commands entered through the terminal board.

The three kinds of automatic tuning are listed below.
Before operating one of the three, the *ENABLE* contact at terminal 24 and the *START* contact at terminal 26 must both be open.

1. Current self-tuning. Can be performed only choosing a predictive control for the current loop by means of the parameter C051 (*CurrLoopSel*) programmed with value **1:Predictive=>J1**. Before doing this, set jumper J1 from position 1 to position 0. Jumper J1 is located on board ES729/1 (installed inside the equipment on control board ES728/2).

On the other hand, this self-tuning is not available if for the current loop you choose a proportional-integral control by means of parameter C051 (*CurrLoopSel*) programmed at the value *0:P1 operating*. This selection is however recommended in case of a DCREG4 in armature feedback or in case of a DCREG2 and generally in all cases where the resistance torque is much higher than the inertia one, or when the output bars of the DCREG do not supply a motor but supply a resistive load.

The command is issued by setting parameter P001 to *1:Current* through the "DEC" or "INC" keys and by pressing the "SAVE" key. When the following message Close *ENABLE* to continue is displayed, close the *ENABLE* contact at term. 24 by closing (if not already done) the KM remote switch that supplies the power section. When the *Press SAVE to continue* message is displayed, press the "SAVE" key again. The autotuning procedure is over when message *AutoTune in progress…* disappears and *P001=0* is displayed again.
The values of parameters P103, P104 are calculated and saved on EEPROM. Moreover, the value of parameter concerning the armature feedback reading is optimised in such a way that while the drive is off, parameter M006 (*Varm*) displays 0V.

N.B. During the self-tuning as above, the alarm A014 (*R out of range*) can trip if the motor rated current, set by par. C000, is too low if compared to the drive rated current. Therefore the drive may never be overdimensioned if compared to the motor, but on the contrary its size must be comparable to or immediately higher than the motor rated current.

2. Speed autotuning. This tuning can be performed for whichever choice of current loop operation and is generally recommended. It can be avoided in case of a DCREG2, of a DCREG4 in armature feedback or when the inertia torque of the load is variable (i.e. a coiler).

The command is issued by setting parameter P001 to *2:Speed* through the "DEC" or "INC" keys and by pressing the "SAVE" key. When the following message *Close ENABLE to continue* is displayed, close the *ENABLE* contact at term. 24 by closing (if not already done) the KM remote switch that supplies the power section. When the *Press SAVE to continue* message is displayed, press the "SAVE" key again. The autotuning procedure is over when message *AutoTune in progress…* disappears and *P001=0* is displayed again.
The values of the parameters P070 and P071, or, alternatively, of parameters P076 and P077 are calculated and saved on EEPROM. Parameters P076 and P077 are calculated instead of the parameters P070 and P071if the possible digital input, that has been configured by setting one of the parameters C130…C135 to the value *8:SecondParmSet*, is closed.

N.b. The speed self-tuning, during which the motor has to physically turn, delivers a positive polarity to the bar A as compared to bar A2.

NOTE

Whenever two different sets of speed loop adjusting parameters have been considered through one of the MDIx configurable digital inputs being set at value *8:Second ParmSet*, then the speed automatic tuning calculates the parameters relating to one of the two sets according to the state of the above mentioned digital input.

3. Autotuning for resistive drop RxI. This autotuning procedure complies with any current loop operation mode and with any speed feedback.
This procedure, which should always be done, allows to compute the value of par. P088 and saves it on EEPROM memory. Par. P088 is used to compute the back-electromotive force and displays it in par. M007 (*BEMF*). Par. P088 value is also used for the armature resistive drop compensation, both for the field current dynamic regulation in field weakening mode and for the armature feedback (in that case, this is possible through par. P086, where one of its values per cent is programmed).

This command is entered by setting parameter P001 to *3:RxI* by using the "DEC" or "INC" keys and by pressing the "SAVE" key. When the following message is displayed (*Close ENABLE to continue*), close the *ENABLE* contact at terminal 24 by closing KM power section contactor. When the *Press SAVE to continue* message is displayed, press the "SAVE" key again. The autotuning procedure is over when message *AutoTune in progress…* disappears and par. *P001 = 0* is displayed again.
During the autotuning procedure, the optimisation of the parameter value relating to the armature feedback reading occurs, so that M006 (*Varm*) displays 0V when the drive is not running.

6.2 RAMPS OVER THE REFERENCE

In parameters ranging from P030 to P039, the operator may program the ramp application to the set reference in order to produce a reference with no value instant variation (discontinuity).
With respect to the references applied when the *START* input is on, the programmable rise and/or fall ramps are separate concerning the positive polarity and the negative polarity of the set reference (P030 ... P033). Some initial/final rounding is also possible either at the beginning of the transient (P038) or at the end of the transient (P039). In addition, when the *START* digital input is disabled, two additional fall ramps may be programmed (*stop ramps*: P034 and P035), also separate concerning the reference positive polarity and negative polarity; the initial/final rounding programmed are not applied to the stop ramps.
The figure below shows a possible example of the reference that can be produced by the ramp circuit.

NOTE

The following inequality is to be verified between the ramp times programmed in parameter P030 ... P033 and the initial/final rounding times programmed in parameters P038, P039: $\frac{P038}{2} + \frac{P039}{2} \leq P030(031)(032)(033)$

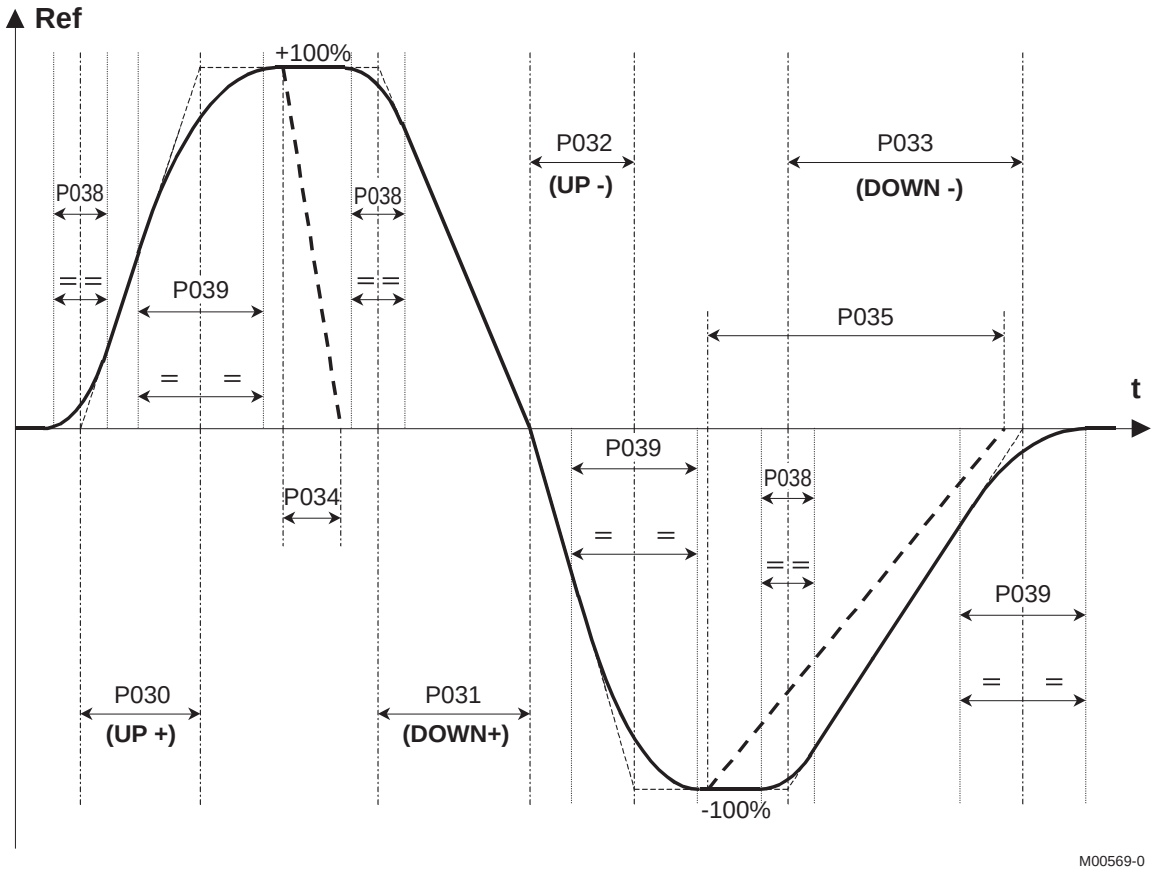
NOTE

As the figure shows, for each ramp transient (rise ramp or fall ramp transient), the duration of the ramp really set is equal to the addition of the time programmed in the relevant parameter, of half the initial rounding time and half the final rounding time.

NOTE

In order to exactly respect the time set for the *stop ramps* in par. P034 and P035, the following equality relations are to be correct:

$P031 \geq \frac{P034}{10}$; $P033 \geq \frac{P035}{10}$.



6.3 MOTOR POTENTIOMETER

This function allows to use an internal variable as a reference, that can be increased or decreased using a digital input *Up* and a digital input *Down* or using the arrow keys.

1. Reference. At least one of the sources selected for the reference through parameters C105 … C108 (*RefSelx*) must correspond to *UpDownRef;* therefore, the *LOC REF* LED is to be on or flashing.
In the standard use of the Motor Potentiometer function, this source is the one selected to form the main reference (*Main Ref*), and the reference obtained will be normally configured as a speed reference, even though it can be configured as a current reference.

2. Increase / decrease commands. The *UpDownRef* internal reference may be increased or decreased using the commands coming from max. three sources among the four available sources that can be selected through parameters C110 … C112 (*SeqSelx*). The terminal, serial connection or field bus commands may be used after configuring one of parameters C130 … C135 (*MDIx*) as *14:Up* and *15:Dn*, or the "∨" and "∧" keys. If an increase command is simultaneously entered with a decrease command, the former will cancel the latter and vice-versa. Two contemporary increment / decrement commands have the same effect as a single command.

3. Ramps over the increment / decrement commands. Whenever an increment / decrement command is enabled, the internal reference is increased or decreased according to the ramp set through par. P040 (*UpDnRefRamp*). When the motor is running, that ramp is in series with the ramp with the *Ref n* reference, which is determined by parameters P030 … P033, so the ramp obtained is the longer one.

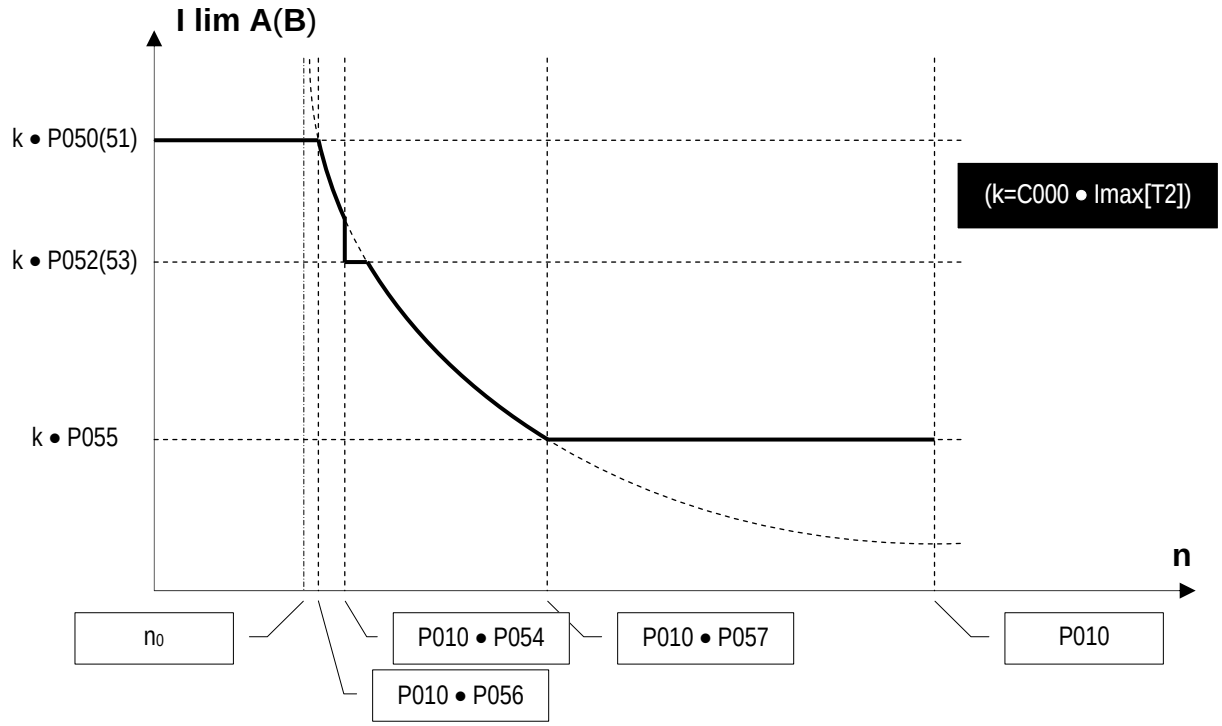
4. Polarity. Par. P250 (*UpDnRefPol*) allows to program whether the internal reference may range from -100 … +100% or whether it may vary between the values with sign - or +.

5. Storing the last reference set. In order to keep the last value stored at each power on or in case of power failure, set par. P251 (*UpDnRefMem*) to *1:Yes*. Otherwise (*0:No* setting) the internal reference will restart from zero.

6. Reference reset. The internal reference value may be set to zero at any time by enabling the digital input set to *14:UpDnRefReset* through one among par. C130 … C135 (*MDIx*). In that case, the internal reference is set to zero with no ramps. If a reset command is simultaneously sent with an increase or decrease command, the reset command has priority.

6.4 CURRENT LIMITATION

The parameters ranging from P050 to P062 variably control the max. current to be supplied to the load.
The figure below shows a possible programming for current limit **I lim A(B)** depending on speed **n** and resulting from the combination of the different configuring modes. The figure refers to converter DCREG4; the parameters in brackets relate to bridge B.



As the figure shows, in the calculation for the current limit, the major value which all other parameters are related to is the k one, equal to product C000•Imax[T2] standing for the rate of motor C000 nominal current less any trimmer hardware limitation (IMAX[T2]). As we discussed above, for the drive normal use, the IMAX[T2] value is to be at 100%, i.e. the *Status* page must **not** display warning A002 (*Imax [T2] < 100%*). Therefore, the parameters shown in the figure represent a value per cent of motor C000 rated current.

1st Mode: **Limit independent of speed**
The current limit may be set at **P050(51)** rate of the motor nominal current.

2nd Mode: **Two-value limit depending on speed.**
The current limit may be defined as a simple two-value function, i.e. two different **P050(51)** and **P052(53)** rates. They are selected whether speed is respectively higher or lower than P054 rate of P010 max. speed.

3rd Mode: **Limit with hyperbolic trend depending on speed.**
The current limit may be defined hyperbolically depending on speed:

$$I\lim A(B) = \frac{c}{n - n_0}$$

In the formula above, n_0 is the max. speed rate of the hyperbole vertical asymptote, whereas c is the constant for inverse proportionality.
In the latter mode, you need to program **P056** rate for the max. speed enabling the hyperbolic step, **P057** rate for the max. speed disabling the hyperbolic step and **P055** rate for the motor nominal current at the end of the hyperbolic step, provided that the motor nominal current rate at the beginning of the hyperbolic step corresponds to P050(51) value.

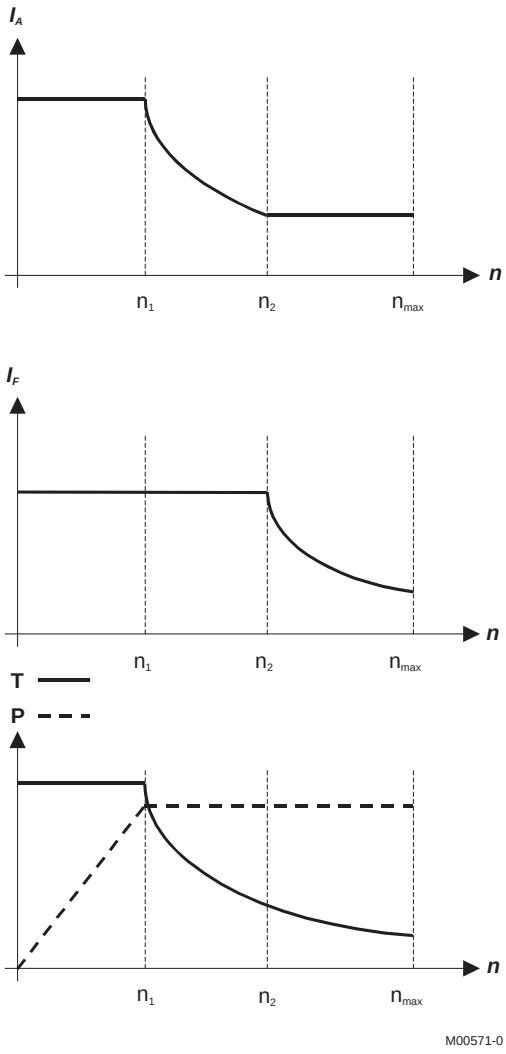
For a better understating, c and n_0 values obtained under such conditions are shown below:

$$c = \frac{P050 \cdot P055 \cdot (P057 - P056)}{P050 - P055}; \qquad n_0 = \frac{P050 \cdot P056 - P055 \cdot P057}{P050 - P055}$$

The operator may also program P057 = 100%, so that the hyperbolic step ends with P010 max. speed.
When the current limit is defined by overlapping two of the modes above or all the modes above, then the current limit enabled time after time will be the **lower** one among the limits relating to each of the modes applied.

The hyperbolic relation of the current limit with respect to speed is generally used if the motor manufacturer imposes that when the speed of rotation increases, the max. current to be supplied to the motor is to increase with a similar law, so as to avoid any switching trouble in the collector.

Another typical application example of the hyperbolic limit is the **mixed control of the armature limit current** shown in the figures.
The three figures show – depending on speed n – the trends of armature max. current I_A, field current I_F, max. torque T and max. power P.



In the first range $0 < n < n_1$, the motor is in full field and the armature max. current is kept constant, so the operation is in constant max. available torque mode. The max. allowable power (as the product of armature voltage by armature current), increases proportionally and attains its max. level at speed n_1.

In the second range $n_1 < n < n_2$, the motor is in full field but the armature max. current decreases hyperbolically, thus leading the max. torque to decrease with speed. The max. available power (as a product of torque by speed) is kept constant, so the operation is in constant max. available power mode.

In the third range $n_2 < n < n_{max}$, the armature current is kept constant but the motor is in field weaking mode, so the max. torque goes on inversely decreasing with respect to speed. The max. available power (as a product of torque by speed, or of voltage by current) is kept constant, so the operation is still in constant max. available power mode.

The current limit value, set at each speed value as we discussed above, may be **increased** (overlimit) by the rate programmed in parameter **P060** and **P061**, for bridge A and bridge B respectively. Such limit current increase is permanent, but if a given max. allowable duty-cycle is not respected for the current required (150% of the rated current for 1min every 10min), alarm A022 *(Drive It Trip)* trips.
Finally, the current limit value, set at each speed value as we discussed above, may be **decreased** using an external command by enabling a digital input programmed for function *4:Clim*. The current limit value enabled is decreased by the rate programmed in parameter **P058**.
The value of the current limit, besides being decreased by a set rate, may also be **continuously decreased** through one of the configurable analog inputs by setting **parameters C120(121)(122)** at one of values *8:Ext.curr.lim. ... 10:BrdgB ext.lim.*

6.5 OPERATION QUADRANTS

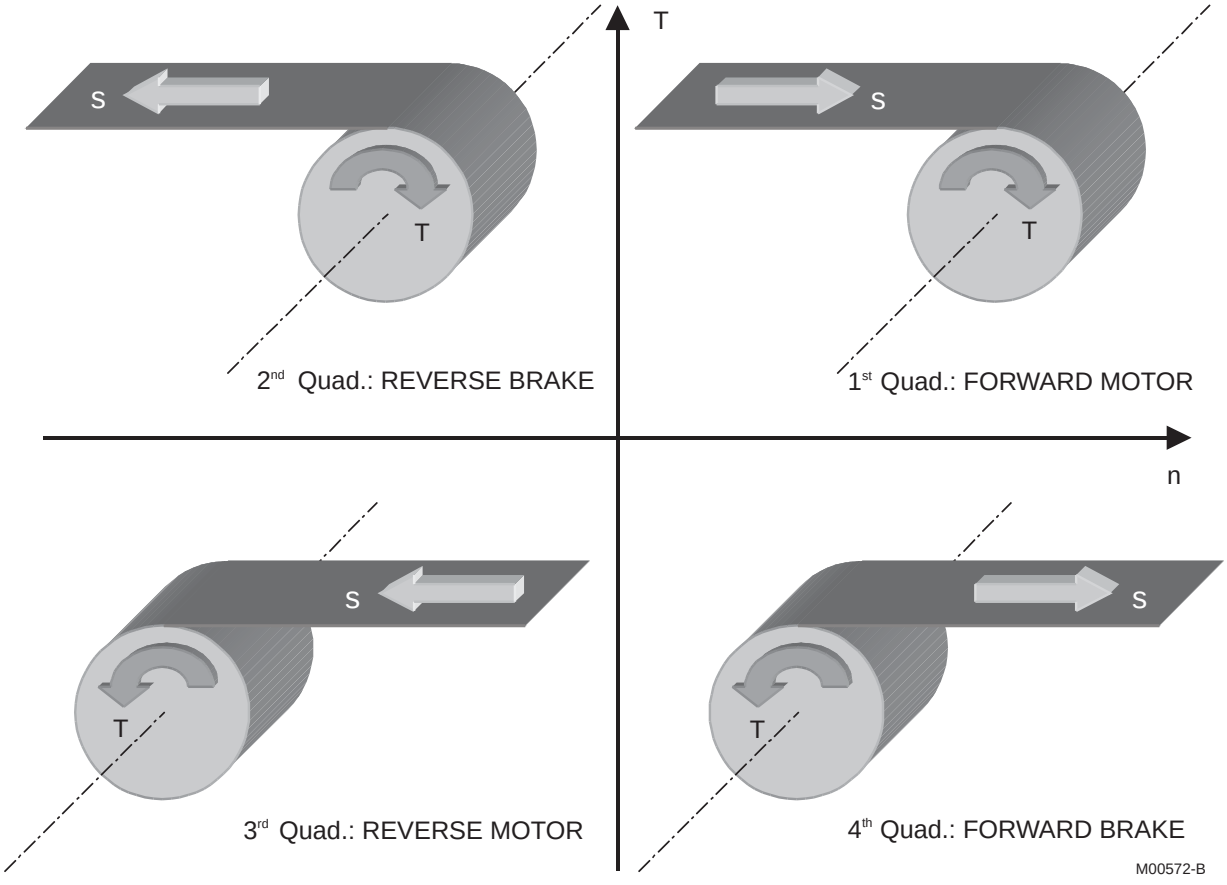
The operation quadrants are defined in Cartesian coordinates with speed (n) / torque (T). The "forward" direction is associated with positive speeds (feedback polarity); bridge "A" is the one which causes motor clockwise rotation (seen sideways in the drawing) with no external torque.
The four quadrants may be identified as follows:

1st Quadrant: Forward direction with motor torque (positive speed feedback and bridge A on).
2nd Quadrant: Reverse direction with braking torque (negative speed feedback and bridge A on).
3rd Quadrant: Reverse direction with motor torque (negative speed feedback and bridge B on).
4th Quadrant: Forward direction with braking torque (positive speed feedback and bridge B on).

Parameters C060 ... C063 allow the quadrant enabling / disabling.
Default operation for DCREG2 is enabled for quadrant 1 and 2 (from SW Vers. D4.01). Operation in quadrant 3 and 4 **cannot be** enabled (only bridge "A" is in).
On the other hand, DCREG4 default operation is assigned to all four quadrants (both bridge "A" and "B" are in).

Whenever a braking torque is produced, an energy regeneration takes simultaneously place from the load to the mains.

What we said above is shown in the following figure, where we suppose that the motor is fit to the axle of a reel winding or unwinding some tensioned material.



The figure below shows **all operating features of drive DCREG2**.

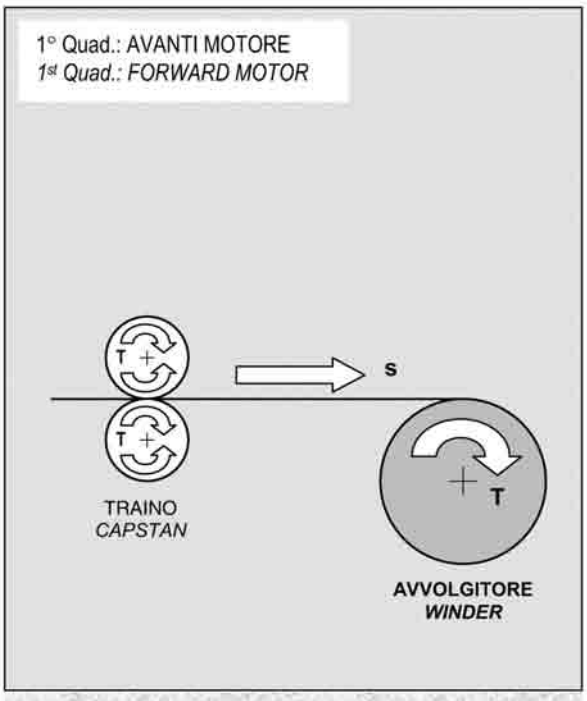
Any equipment for the control of a motor may perform either a speed or a torque control.
In the four cases below, DCREG2 is used to motorize a winder, an unwinder or an elevator. The driving motor (if any) is supposed to be controlled by an external device. In the figure below, letter *T* stands for the torque direction, whereas letter *s* stands for the motion direction.
Note that default operation for DCREG2 is enabled for quadrant 1 and 2 (from SW Vers. D4.01).

Case A. 1st quadrant: tension control while winding. The driving motor controls the material feeding speed (current limitation must never be attained), whereas the winder motor controls the applied torque. DCREG2 operates in current limitation mode with a positive speed reference, which is always higher than the material feeding speed. Otherwise, DCREG2 may directly work with a preset current reference. The driving motor will generally apply an opposite torque with respect to the material feeding direction, except when the tension controlled by the winder is very low and the material friction is not negligible. In this case, the driving motor will have to generate a forward torque as well.

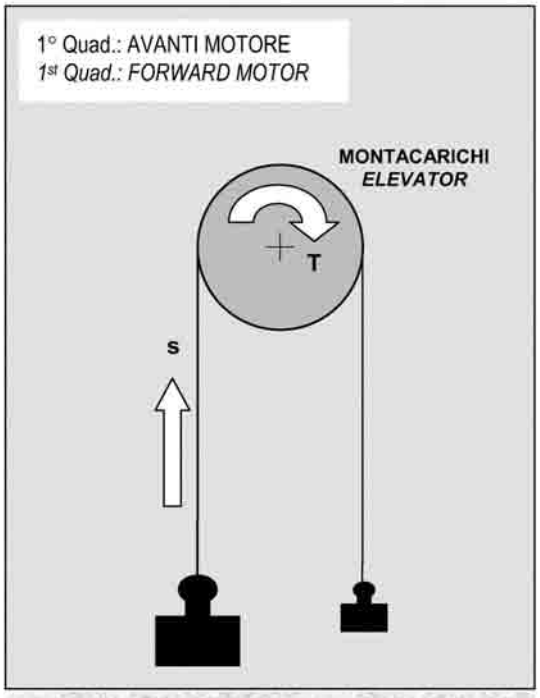
Case B. 1st quadrant: lifting speed control. By default, DCREG2 speed reference is a positive one, and the weight of the material to lift is to be heavier than the counterweight - but not as heavy as to determine the drive operation in current limitation mode, thus compromising the forward speed control. If the material to be lifted was lighter than the counterweight, the motor would be pulled by the counterweight and would accelerate in a forward direction, while drive DCREG2 would be kept in neutral (zero current).

Case C. 2nd quadrant: tension control while unwinding. The driving motor controls the material feeding speed (current limitation must never be attained), whereas the unwinder motor controls the applied torque. DCREG2 operates in current limitation mode with a speed negative reference, whose absolute value is always lower than the material feeding speed. If the material is to be tensioned when the machine is standstill, the drive should use a positive forward reference (which will be correct in any other case). Otherwise, DCREG2 may directly operate with a preset current reference. The driving motor generally applies a reverse torque - with the same direction as the material feeding. In the unwinder motor, the torque direction is opposite to the speed direction; as a result, DCREG2 regenerates some energy from the motor to the supply mains.

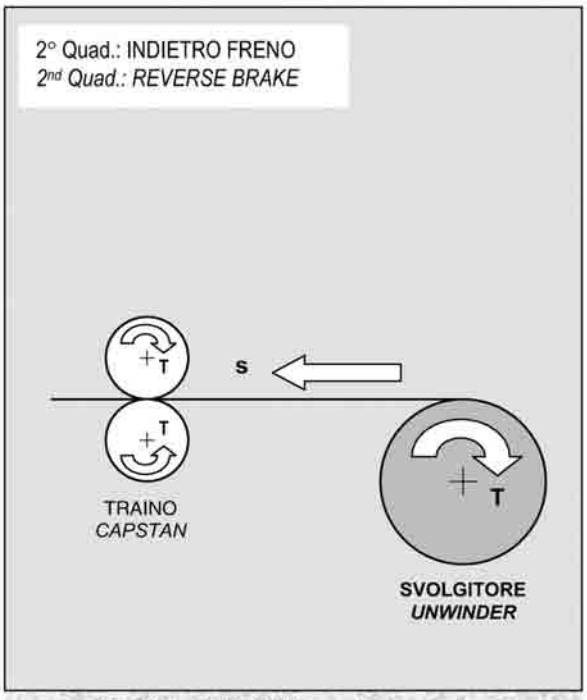
Case D 2nd quadrant: speed control while lowering. By default, DCREG2 has a negative reference; the weight of the material to lower is to be heavier than the counterweight - but not as heavy as to determine the drive operation in current limitation mode, thus compromising the reverse speed control. If the material to be lowered is lighter than the counterweight, the motor would be pulled by the counterweight and would accelerate in a forward direction, while drive DCREG2 would be kept in neutral (zero current). The torque direction is opposite to the speed direction; as a result, DCREG2 regenerates some energy from the motor to the supply mains.



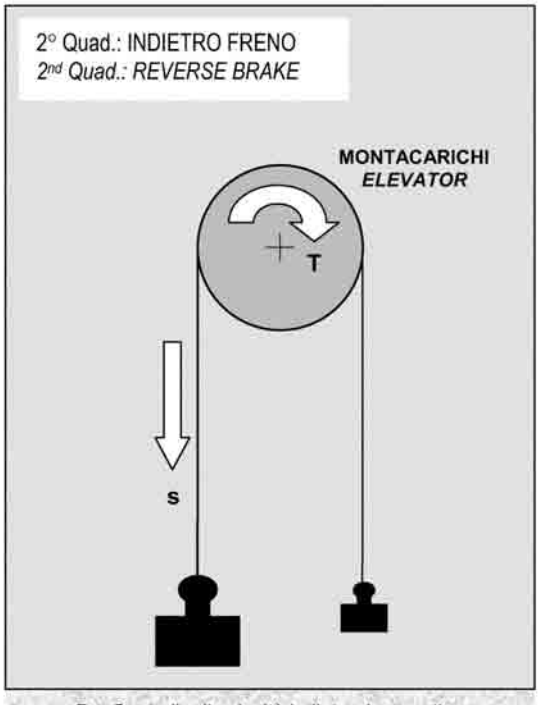
A . Controllo (limite)di corrente non rigenerativo
A . Non regenerative current control (limitation)



B . Controllo di velocità avanti non rigenerativo
B . Non regenerative forward speed control



C . Controllo (limite)di corrente rigenerativo
C . Regenerative current control (limitation)



D . Controllo di velocità indietro rigenerativo
D . Regenerative reverse speed control

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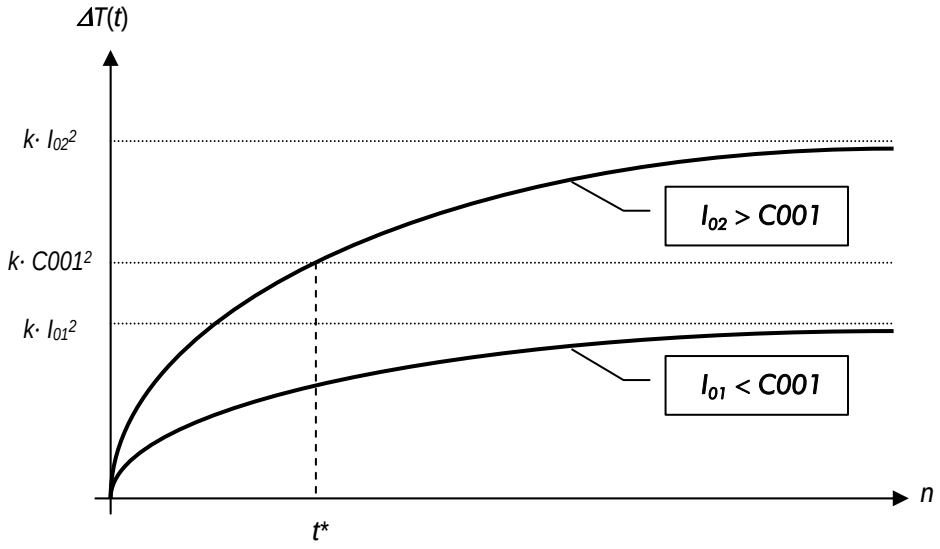
6.6 MOTOR HEATING THERMAL IMAGE

DCREG converter's software is able to detect the motor rise in temperature. A motor heating, i.e. the rise in temperature with respect to ambient temperature $\Delta T(t) = T(t) - T_{amb}$ of a motor supplied with constant current I_0, follows a curve

$$\Delta T(t) = k \cdot I_0^2 \cdot \left(1 - e^{-\frac{t}{\tau}}\right)$$

where τ is the motor thermal time constant and k is a proportional constant with [°C / A^2] as units of measure.

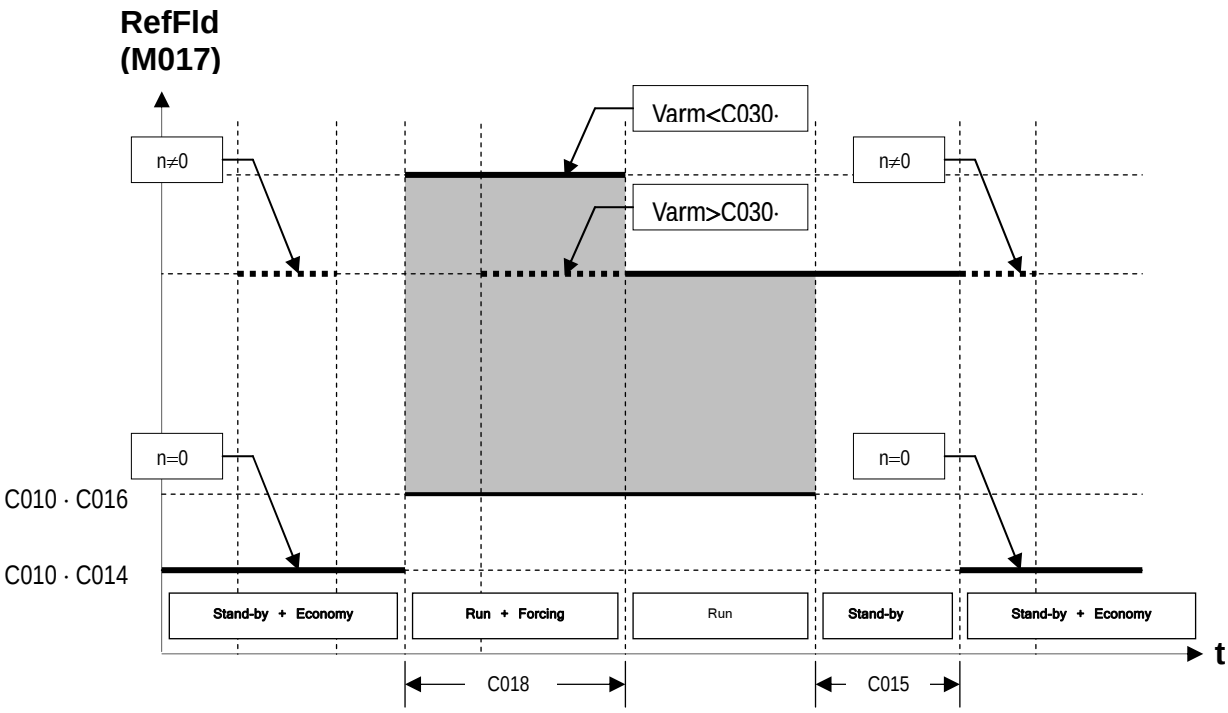
We may therefore infer that, once temperature has stabilized, the rise in temperature will be proportional to the current second power, as it is equal to $k \cdot I_0^2$.
The figure below shows the heating of a motor supposing it is fed with two different current values (I_{01} and I_{02}) which are quantified depending on the reference current represented by parameter C001.



The reference current value programmed in parameter C001 is by default 110% of motor rated current.
Therefore, the rise in temperature is never to exceed the max. allowable temperature, i.e. $k \bullet C001^2$ (temperature allowable value when the motor runs regularly with a current equal to C001).
With a current equal to I_{02}, alarm A021 will trip in instant t^*.
For the motor overtemperature protection, the correct setting of the thermal time constant value programmed in parameter C002 (default value is 300s) is then needed.

6.7 FIELD REGULATOR

DCREG2 and DCREG4 drives are equipped with an internal field regulator that may be used both to set a **field current fixed value** and for a **dynamic regulation in field weakening mode**.
In both cases, the field current reference displayed in par. M017 (*RefFld*), so the relevant current, may be assigned the values shown in the figure below.



First case. The dynamic field regulation in field weakening mode is not required. The **nominal field current** is set in parameter C010 (*IfidNom*).

As soon as the run command is sent and for the time set in par. C018 (*FldFrcTime*) the **field forcing function** may be enabled, which increases the field current by the value per cent set in par. C017 (*FldFrcLevel*) in order to have a temporary torque *boost*. This will have no effect if the field flux is saturated. The field forcing will be always disabled, also when the time set in par. C018 is not yet over, if the armature voltage reaches approx. 66% of the value programmed in par. C030 *(VmainsNom)*.

Once the drive run is over, the **economy function** may be enabled. This function allows the field current to be decreased by the value per cent set in par. C014 (*FldEcoLevel*) as soon as the drive run is over and once the delay set in par. C015 (*FldEcoDelay*) is over. This may be useful when an energy saving function is needed or when the motor temperature is to constantly exceed a min. value (anticondensate function).

If a min. speed of rotation is detected when the drive is not running (motor pulled), the field current will be brought to the nominal value set by par. C010.

Second case. Another typical use of the field regulator is the **dynamic regulation in field weakening mode** depending on the speed change. This may be used to control DC motors designed for operating in the two constant available max. torque / power sections. Of course, said function may be mixed with the others.

This operating mode may be used both when a relatively large torque is needed (at a low speed) and when a relatively high max. speed is needed (but with a smaller torque), as for winders or unwinders in tension control.

In order to enable this operating mode, the drive starts decreasing the field current when the speed required increases, so that the back-electromotive force does not exceed the nominal value.
Suppose the motor ratings are the following as far as the field weakening is concerned:

Nominal armature voltage	400V
Nominal field voltage	220V
Nominal field current	9A (with motor at zero speed or with not yet weakened field)
Field weakening starting speed	1000 RPM
Min. field current	1.8A (with motor at its max. speed)
Max. speed	4000 RPM

First, we have to consider that the $220V_{DC}$ voltage required for the field exceeds max. $205V_{DC}$ that can be obtained with a field regulator power supply (terminals E1-2) ranging from 200 to $240V_{AC}$, so a voltage equal or larger than $400V_{AC}$ is required for said terminals.

As we stated in the chapter concerning the basic start-up procedure, the **RxI resistive drop autotuning** is to be performed by setting par. P001 to *3:RxI*. Starting from this value and the value of the rated armature, the drive will estimate the nominal back-electromotive force (max.) to be adjusted.

The parameters below are to be set, supposing a DCREG.350 is used, with a 15A nominal field current:
P010 *(nFdbkMax)* = 4000 RPM

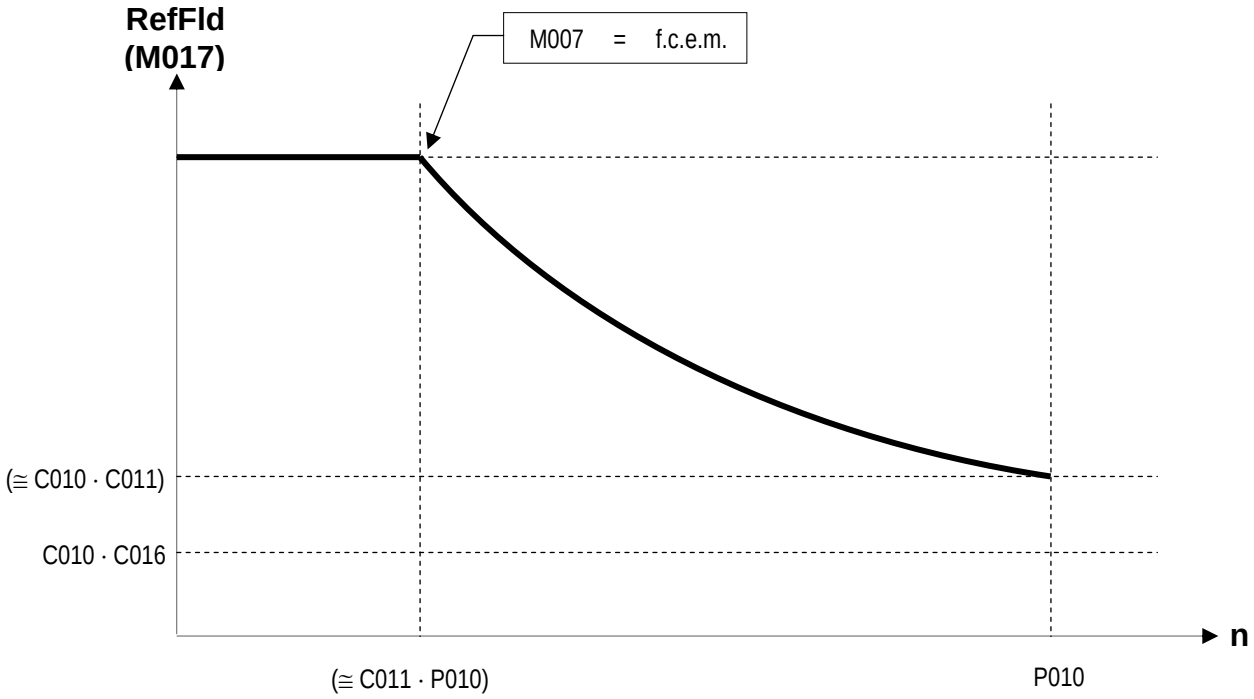
C010 *(IfldNom)* $= \frac{9}{10} \cdot 100$ = 60% (9A with respect to the drive 15A rated current)

C011 *(BaseSpeed)* $= \frac{1000}{4000} \cdot 100$ =25% (1000 RPM of weakening starting with respect to max. 4000 RPM)

C012 *(VarmNom)* = 400V

C016 *(IfldNom)* $= \frac{1.8}{9} \cdot 0.75 \cdot 100$ = 15% (75% of min. 1.8A with respect to 9A rated current)

The parameters above are required for the field weakening correct operation and the trend with respect of the field current reference speed displayed in par.M017 (*RefFld*) is shown in the figure below.



The value set in par. C016 *(IfldMinLim)* represents the min. limit for the field current provided that the drive is running. We recommend that this limit be never set below the min. current that the regulator will actually retrieve. Leave a 25% safety margin.

Field value 1.8A at the max. speed is **not to be set in any parameters**, as it will automatically be retrieved by the control loop of the back-electromotive force.

Always try to set in par. C016 the min. limit, depending on the field current at the max. speed, as sometimes the speed of rotation may reach very high levels, which may damage the mechanical parts. For example, this may occur if the max. speed has been set at a very high level (a wrong terminal has been connected in case of a tacho feedback, or the setting of transduction constant C072 or CO74 is wrong), or the motor could be accelerated by an external torque.

In both cases, the field regulator will keep decreasing the field current in order to keep the back-electromotive force constant and Alarm A010 (*Armature Overvoltage*) will not trip: that's why C016 min. value is to be set. If an additional field current decrease is inhibited, Alarm A023 (*Ifld Underlimited*) trips and the drive is locked.

The dynamic regulation of the field current in field weakening mode is possible only in **tacho or encoder feedback mode**, not in armature feedback mode. If a speed feedback failure occurs, the automatic switch may be programmed towards the armature feedback by setting par. C155 to *2:Switch to Varm*.

In order to **keep the speed of rotation approx. constant** with the same reference, the max. armature voltage is to be programmed in par. P011. Always referring to the motor chosen in the example above:

P011 *(VarmMax)* = C012 *(VarmNom)* = 400V

6.8 CONFIGURABLE DIGITAL OUTPUTS

DCREG drive is provided with 5 digital outputs (relay normally open contact). Any output may be assigned to some configurations: for further details, see the chapter relating to par. P170(176)(182)(188)(194) and to the others chapters relating to the configurable digital outputs.

Depending on the **configuration** assigned, every output enables either when a certain logic condition occurs (e.g. *3:Motor at Speed*) or when an analog quantity exceeds a certain level (e.g. *8:Ifld Threshold*).

In both cases, the drive may be programmed in order to have a particular **delay** before enabling or disabling the digital output.

At the same time, the **logic** may be defined, i.e. the digital output enabling determines the relay excitation (so the contact closing) or the relay disexcitation (so the contact opening).

Moreover, if the digital input is to be enabled when an analog quantity exceeds a particular level, the enabling **level** and the **hysteresis -** necessary to avoid any relay high frequency vibration when the relevant analog quantity is near the level chosen - are to be defined.

For instance, suppose configurable digital output MDO1 is to be enabled when the armature current reaches 38% of the drive nominal current. A hysteresis is to be entered in said current threshold, equal to 10% of the current level chosen. The output enabling is to have a 10-second delay. The output disabling is to have a 18 seconds delay.
In order to obtain this, the following setup is required:

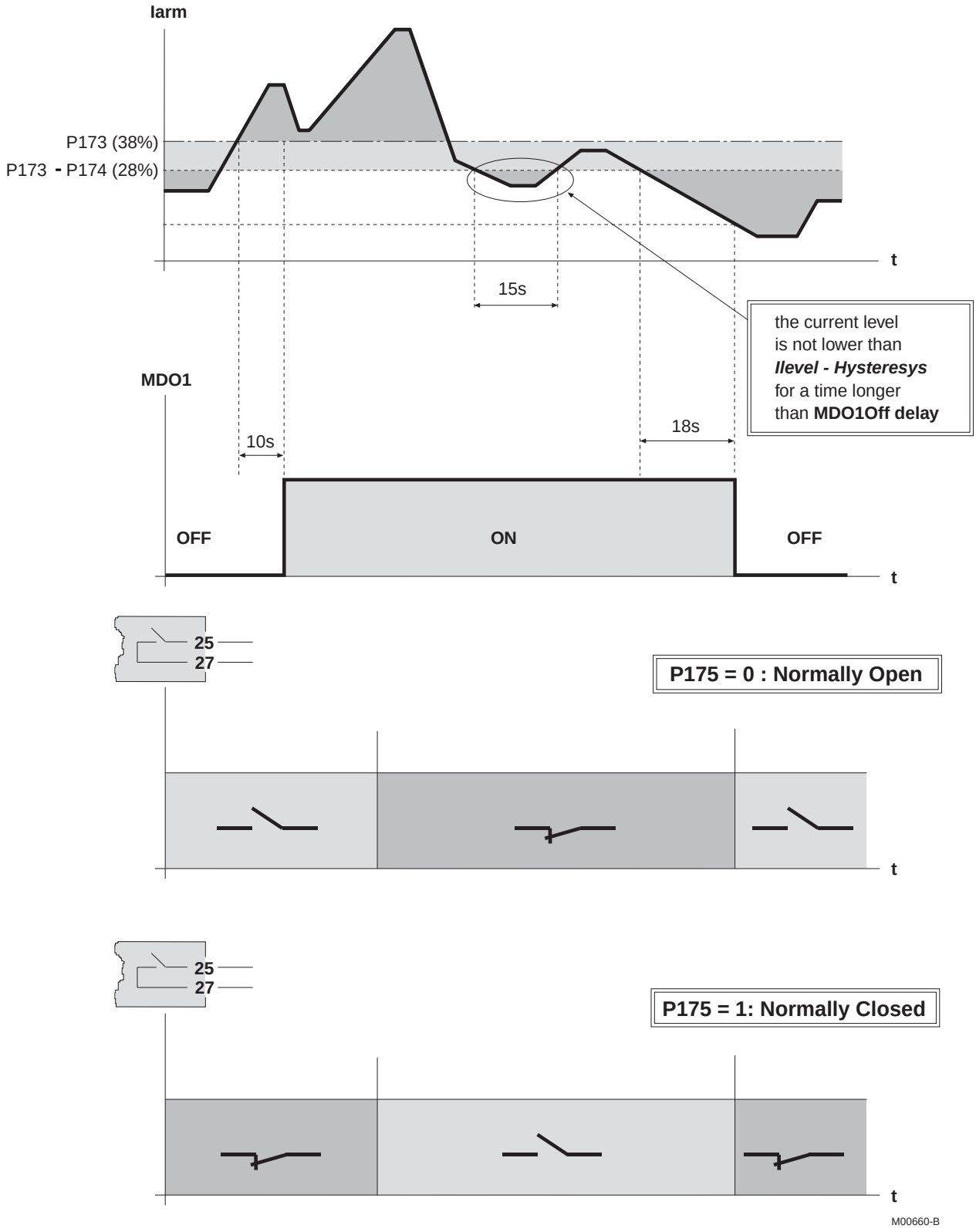
P170 = *2:Iarm Threshold*
P173 = 38%
P174 = 10%
P171 = 10 s
P172 = 18 s

The first diagram in the following figure shows a possible trend of the time-depending armature current. The second diagram shows MDO1digital output enabling and disabling. The third and fourth diagram show the physical state of the contact at terminals 25-27 respectively, provided that the logic setup is the following:

P175 = *0:Normally Open*

or

P175 = *1:Normally Closed*.

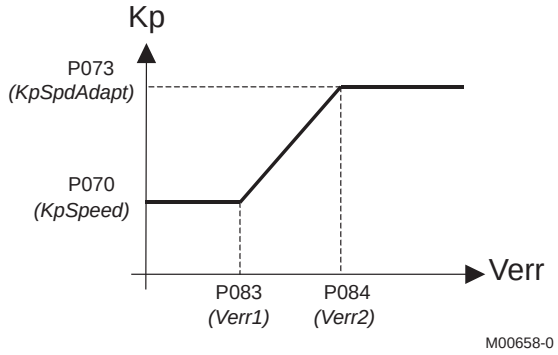

Iarm
P173 (38%)
P173 - P174 (28%)
t
15s
the current level
is not lower than
Ilevel - Hysteresys
for a time longer
than **MDO1Off delay**
MDO1
10s
18s
OFF
ON
OFF
t
25
27
P175 = 0 : Normally Open
t
25
27
P175 = 1: Normally Closed
t
M00660-B

6.9 SPEED PARAMETER AUTOADAPTATION

When the speed reference value is suddenly changed and the load speed is not able to follow such variation, the speed loop proportional gain in the transient is to be large enough to avoid any excessive speed overshot both during acceleration and deceleration. On the other hand, once the speed is constantly kept at the new value set, said value is generally too high for the speed loop and may cause some instability.

DCREG allows to enable the SPEED PARAMETER AUTOADAPTATION through par. P082 *(AdaptCtrl)*. This parameter allows the **proportional gain** to have a rather high value, selected through par. P073 *(KpSpdAdapt)* when also speed error value *Verr* (M002 up to SW Vers. D3.7) is remarkable - so when the speed value has not yet reached the reference value. When the load speed reaches the new value set, so the speed error decreases until it becomes null, the proportional gain is gradually reduced until it reaches the original value set in par. P070 *(KpSpeed)*: the transition between the two values is not sudden but it gradually occurs between the error value set in par. P083 *(Verr1)* and the one set in par. P084 *(Verr2)*.

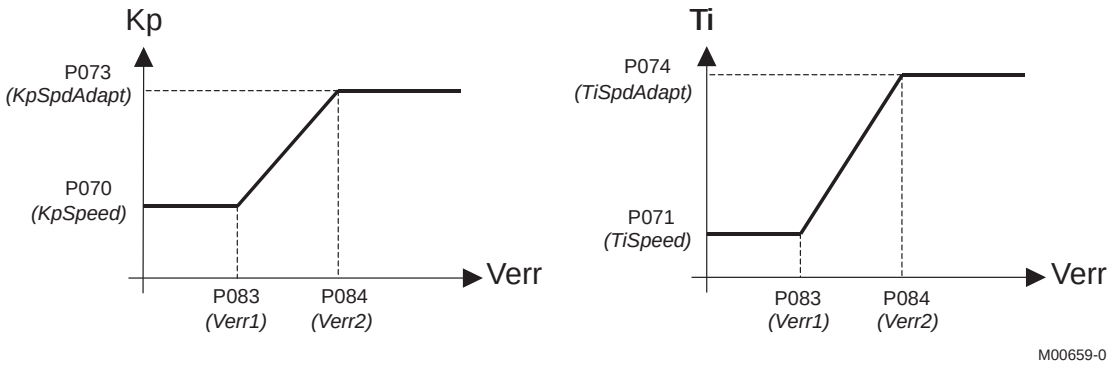
This may be seen in the figure below.



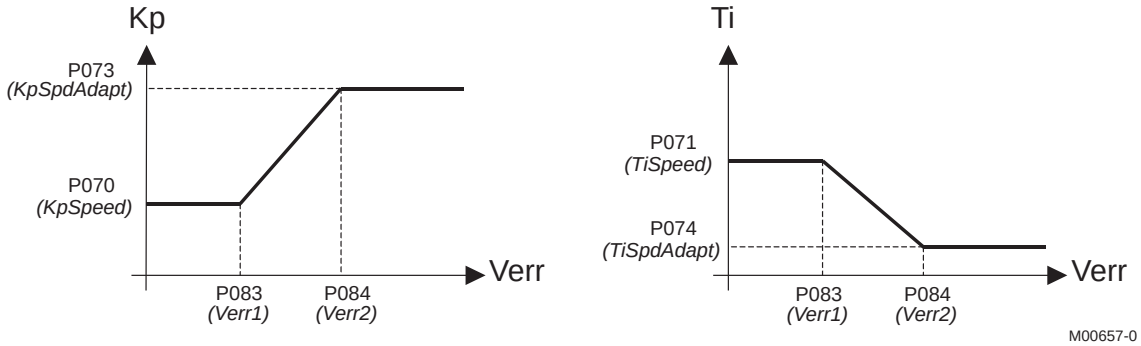
The speed parameter autoadaptation also controls the speed loop **integral time**. During the transient, the integral time may be changed starting from the original value set in par. P071 *(TiSpeed)* up to the new value set in par. P074 *(TiSpdAdapt)*. In that case as well, the transition between the two values gradually occurs between the error value set in par. P083 *(Verr1)* and the one set in par. P084 *(Verr2)*.

Two opposite cases are shown below, requiring an opposite integral time change.

1. Constant-load quick reference change. This may happen with an inertial load, when the drive is in current limit mode due to a sudden speed reference change.
In that case, *to avoid any speed overshot at the transient end*, the proportional gain is to be temporarily increased and the integral time is to be longer, as is shown in the figure below.



2. Constant-reference quick load change. This may happen in a machine-tool rotating at a constant speed when it starts a piece processing.
In that case, *to avoid any speed decrease at the transient beginning*, the proportional gain is to be temporarily increased and the integral time is be shorter, as shown in the figure below.



Finally, if a motor has a different mechanical time constant, a different reduction ratio, a different load inertial moment, and so on, the speed loop regulation parameters it requires are different than the standard ones.
In that case, the configured digital input is to be closed by setting one of par. C130 ... C135 at *8:Second ParmSet*. The new values of the proportional gain and the speed loop integral time will be the ones programmed in par. P076 (*KpSpeed2*) and P077 (*TiSpeed2*) respectively instead of the original values set in par. P070 (*KpSpeed*) and P071 (*TiSpeed*).

During the transient, the parameter autoadaption function - if enabled - will bring the proportional gain and integral time values to the new values set in par. P079 (*KpSpdAdapt2*) and P080 (*TiSpdAdapt2*) respectively.

6.10 ELECTROMAGNETS APPLICATION

6.10.1 DRIVE POWER CONNECTIONS AND PROTECTING DEVICES

DCREG4 thyristor converter can be used to power very inductive loads, such as electromagnets.
Applications problems due to this type of load - that can be compared to a ohmic resistance series-connected to a very strong inductance - have been solved by a control algorithm specially developed for DCREG4 converters.
With very inductive loads, safety problems may occur in case of power failure due to faults in the system or to unsafe installations. Power failure, in conjunction with the high inductive value of the magnet, can cause instant over voltage up to some thousands of Volts. The only way to protect the converter from those over voltage conditions consists in taking special measures when installing the equipment (see sections below).

Over voltage depends on how quick magnet power failure is:

$$V = L\frac{dI}{dt}$$

Because L value is very high (approx. 1 Henry), the voltage value can reach instant values up to some thousands of Volts.
To protect the converter, the most effective measure consists in installing clamping unit **CU400**, which protects a DC converter when it is subject to dangerous over voltage conditions generated when the current conduction mesh of the magnet unexpectedly opens.

Energy stored in the magnet is obtained as follows:

$$E = \frac{1}{2}L\,I^2$$

Energy in the magnet is absorbed and stored in an RC-type clamping circuit, where over voltage is limited by a capacitor and energy is dissipated by a resistance, which are both integrated in the clamping circuit.
Clamping unit CU400 must be connected directly to the converter output by means of fuses equipped with a micro switch detecting power failure.
To ensure proper clamping, unit CU400 must be connected directly to the converter DC side. To suppress the first current peak generated by the capacitor, this is precharged when connecting the main voltage of the mains (typically 400 VAC) to the relevant terminals.
(Wiring diagram and terminal board are shown in Figure 1).
If the current conduction mesh on mains side opens (due to sliding contacts or other), or wires connecting the magnet to the converter are torn, the electric arc generated when current is cut off is limited by the clamping circuit, ensuring that over voltage does not exceed safety values.

This setting is essential for electromagnets installed on bridge cranes where 3-phase supply voltage L1-2-3 is derived from the mains through sliding brushes that could accidentally open.

Multiple clamping units CU400 can be parallel-connected to the output of a unique converter. Each clamping unit is indicated for a rated DC current of approx. 150A as a maximum allowable value.
For more details, see CU400's Instruction Manual.

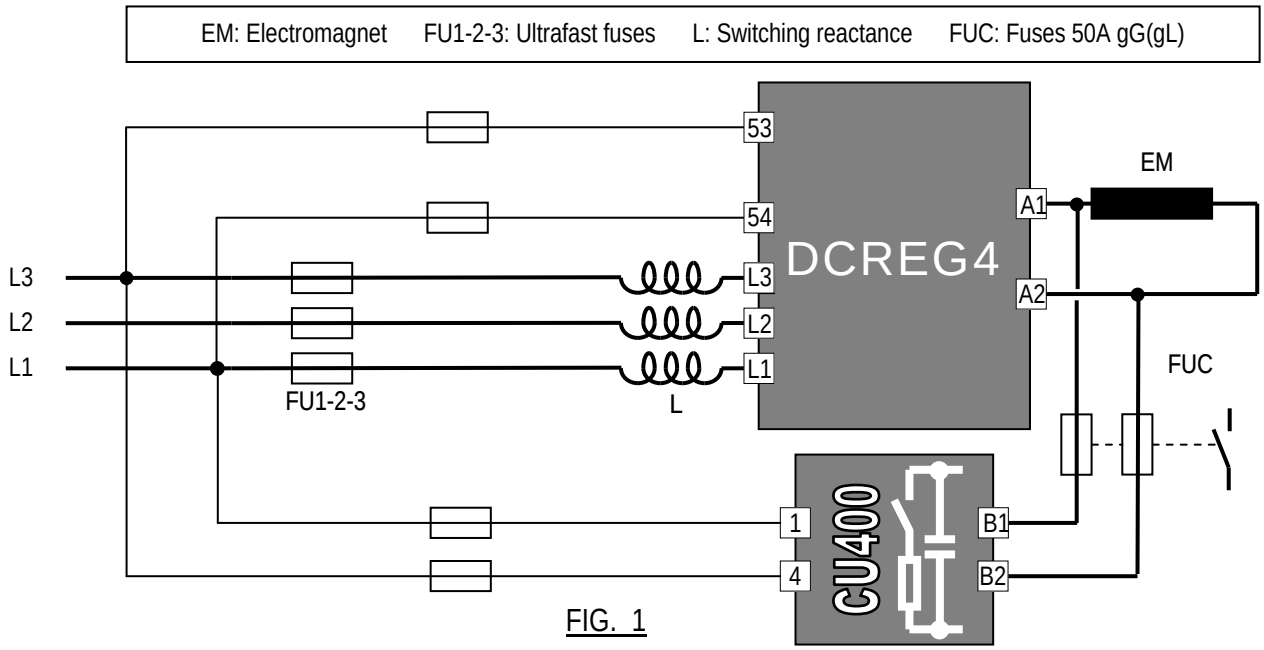


FIG. 1

Otherwise, if you suppose that over voltage occurs only when the conduction mesh opens on mains side (3-phase supply voltage L1-2-3 derived from sliding brushes), another protective measure exists.
On mains side, install an **autotransformer** (see Fig. 2) which ensures current flowing even if one or more mains phases open.
To ensure the *boost* function (see below), voltage in the autotransformer secondary circuit should equal 1.5 … 2 times the rated voltage of the electromagnet.
Apparent power of the autotransformer should be at least 50% stronger than DC power on electromagnet side. If a real autotransformer is used (not an isolating transformer), voltage in the secondary circuit should be at least 10 … 20% weaker than voltage in the primary circuit, so as to avoid installing any switching inductance.

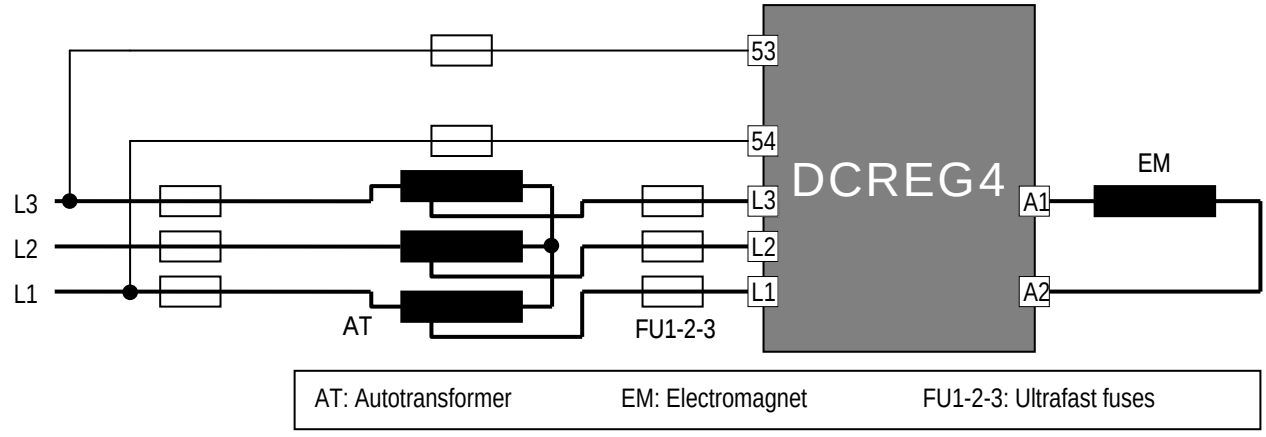


FIG. 2

Finally, a third protective measure consists in using only a switching reactance on mains side (switching reactance is shown in Fig. 3).
This is the cheapest solution, but no protection is ensured, because no closing link of the magnet current is provided in case of power failure or output wire failure.
In that case, SCR modules are damaged by the over voltage caused by the magnet.

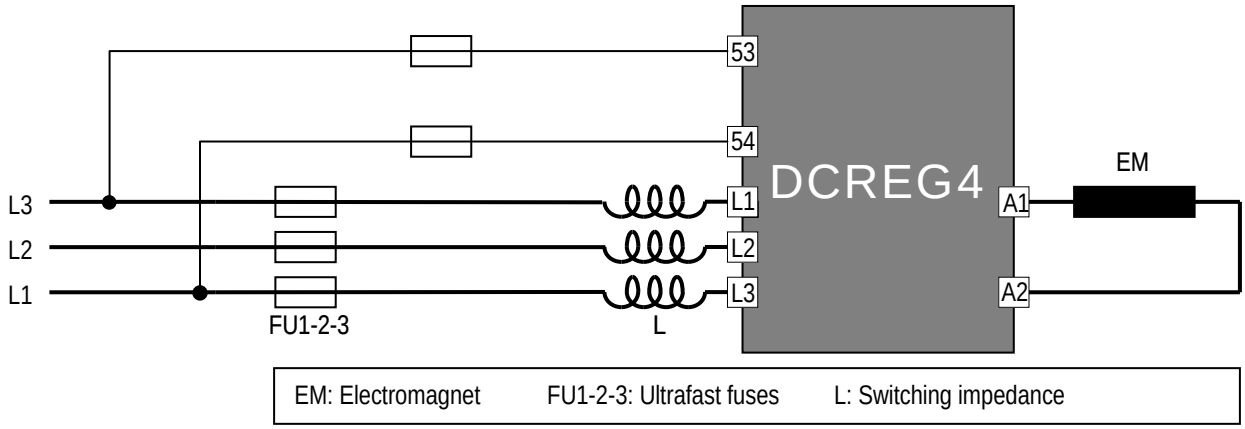


FIG. 3

6.10.2 DCREG4 ELECTROMECHANICAL DIAGRAM FOR REFERENCE SWITCHING

The diagram in Figure 4 illustrates how commands and references are managed both for magnetization/demagnetisation and for counter-energizing, which is essential to suppress residual magnetization.
If relays are used instead of a PLC, relays controlled by DCREG4's digital outputs may be equipped with AC or DC coils, provided that the maximum allowable power value is not exceeded. Because of weak current values (milliAmperes), use low capacity relays to make sure that contacts properly close.

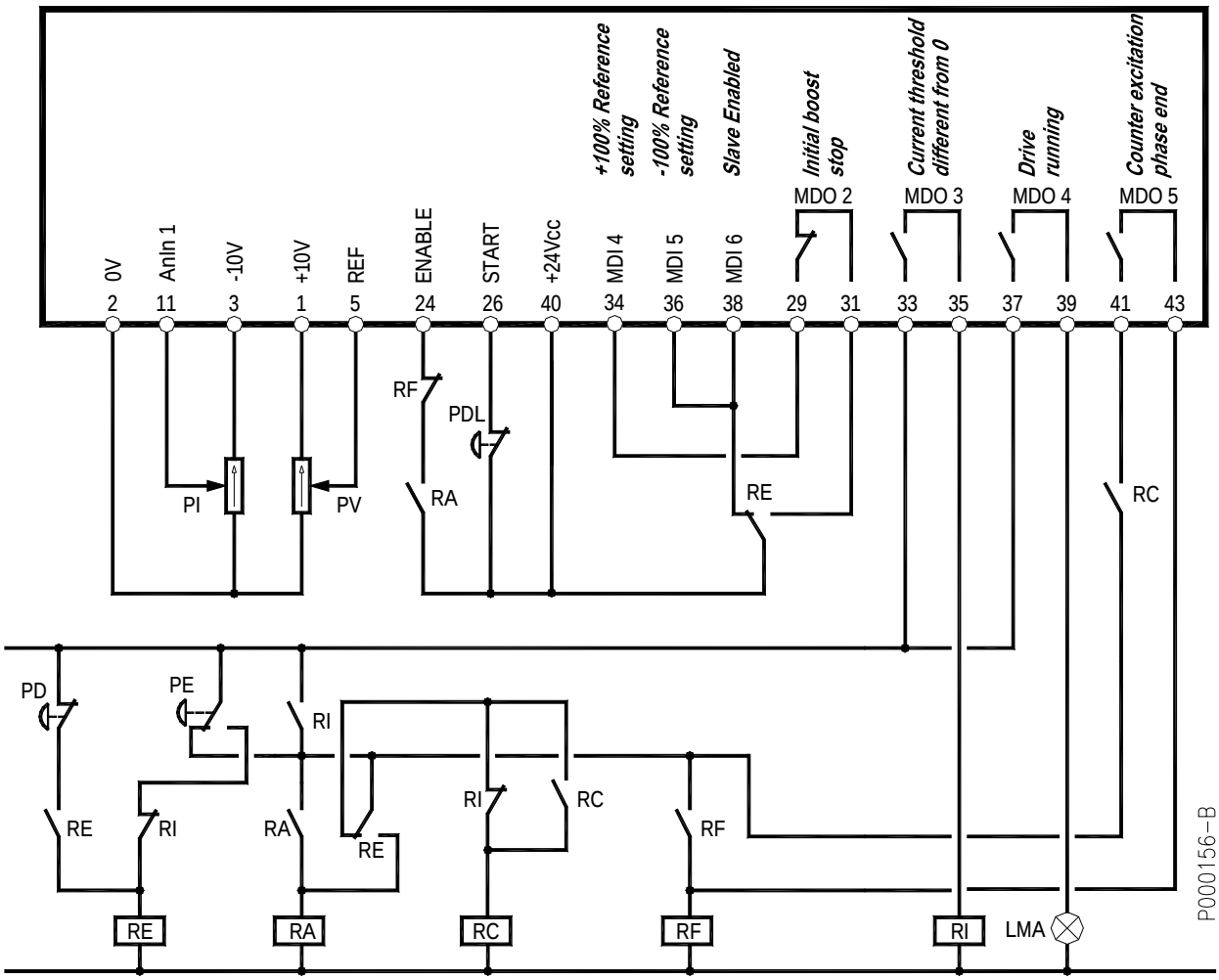


FIG. 4

LEGEND

LMA: Indicator light, magnet on
PD: Button, magnet deenergizing
PDL: Button, magnet partial deenergizing
PE: Button, magnet energizing
PI: Potentiometer, counter-energizing current
PV: Potentiometer, energizing voltage
RA: Relay, converter enabling
RC: Relay, storage of counter-energizing beginning
RE: Relay, storage of energizing/deenergizing commands
RF: Relay, end of cycle storage
RI: Relay, current in the magnet "on"

6.10.3 DCREG4 SETTING PARAMETER VALUES DIFFERENT FROM DEFAULT VALUES

P003 = 1	*Advanced programming level*
P011 = 1.15 x $V_{MAINSnom}$	***Boost DC voltage** forcing energizing current*
P031 = 10 s	*Down ramp time of positive voltage reference*
P034 = 60 s (example)	***Down ramp during partial demagnetisation***
P059 = 0.01 %/µs	*Ramp over current reference*
P070 = 1	*Proportional gain kp of voltage regulator*
P071 = 0.1 s	*Integral time Ti of voltage regulator*
P100 = 1.5	*Proportional gain kp of current regulator*
P101 = 10 ms	*Integral time Ti of current regulator (discontinuous operation)*
P102 = 100 ms	*Integral time Ti of current regulator (continuous operation)*
P122 = $\frac{V_{nom}}{P011} \cdot 100$	*Gain over REF for **magnet rated voltage** as a percentage of boost voltage*
P128 = 20% (example)	*Gain over AnIn 1 for **counter-energizing inverse current***
P176 = 5	*Digital output MDO 2 set as Drive Running*
P177 = 3 s (example)	*Digital output MDO 2 enabling delay for **starting boost duration** setting*
P181 = 1	*Digital output MDO 2 set up with normally closed logic*
P185 = 5%	*Current threshold for digital output MDO 3 as a percentage of $I_{DRIVEnom}$*
P195 = 3 s (example)	***Time period of counter-energizing stage** with inverse current*
P211 = +100%	PresetSpd 1 for boost upon energizing
P212 = -100%	PresetSpd 2 for boost upon deenergizing
C000 = $\frac{I_{EM\ nom}}{I_{DRIVE\ nom}} \cdot 100$	***Magnet rated current** expressed as a percentage of the converter size*
C030 = $V_{MAINSnom}$	***Three-phase, rated supply voltage** for the converter*
C070 = 4	*Armature feedback*
C120 = 10	*Auxiliary input AnIn 1 set as current limit for bridge B*
C134 = 2	*Digital input MDI 5 ready for Preset Speed B setting*
C135 = 6	*Digital input MDI 6 ready for Slave setting*
C150 = 1	*Alarm A001 trip disabled (Field current failure)*
C151 = 1	*Alarm A004 cleared (Load loss)*
C153 = 1	*Alarm A006 trip disabled (Unstable mains frequency)*
C154 = 1	*Alarm A007 trip disabled (No supply phase)*
C156 = 1	*Alarm A010 trip disabled (Output over voltage)*
C157 = 1	*Alarms A016/17 trip disabled (Tolerance exceeded by mains voltage)*
C170 = 1	***Selection of inductive load***

NOTES

1. Set **P000 = 1** to alter the parameters above.
2. **Save** all changes made to the parameters above. The remaining parameters are expected to be left at their default values (factory setting).
3. If an oscilloscope is used to monitor the response to a current reference step, temporarily change the value of parameter **C133** from 1: *Preset Speed A* (default value) to **6: *Slave Enabled***. If so, the reference set on potentiometer PV (that must not be set at its max. value to avoid current limit) becomes a current reference, for the time set in P177. The current waveform may be read on terminal 8 by setting par. **P150** to **9: *ArmatureCurr***.

6.10.4 DCREG4 OPERATION DESCRIPTION

If button **PE** is pressed, relay **RE** energizes, self-maintaining.

When **PE** returns to its initial position, relay **RA** energizes as well, self-maintaining.

Its contact on terminal 24 for *ENABLE* closes and the converter starts delivering output voltage. Indicator light **LMA** comes on to indicate that the magnet is on.

Closed contact of digital output *MDO 2* keeps digital input *MDI 4* active on terminal 34 for the time set in P177; DC output voltage is set (with par. P011 and P211), which is equal to mains 3-phase voltage increased by 15% (e.g. $460V_{DC}$ with $400V_{AC}$).

Max. positive voltage which may be delivered by the converter with the default value of par. P230 (*AlfaMin*) is equal to $V = V_{SUPPLY} \cdot 1.36 \cdot \cos \alpha Min$ (approx. $+470V_{DC}$ with $400V_{AC}$).

Then, the *boost* function activates, which considerably reduces the current rise time.

Current will reach the magnet rated value set in C000 within a given time. Even though the max. voltage reference is kept set for a longer time (par. P177), voltage delivered to the magnet terminal will drop anyhow (converter in current limit).

As soon as current is other than zero, *MDO 3* contact closes, thus energizing relay **RI**.

If energizing button **PE** is pressed at any moment, the duty cycle of the equipment is not affected, thanks to contact NO of **RI** parallel-connected to contact NC of button **PE** and to contact NC of **RI**, which is series-connected to contact NO of button **PE**.

When the time set in par. P177 is over, contact *MDO 2* opens, and the reference becomes the magnet rated voltage set in potentiometer **PV**, whose full-scale value is set in par. P122.

Switching from the max. voltage reference to the rated reference of the magnet, current drops, due to a larger resistance of the electromagnet winding when this heats up. Otherwise, if *boost* is set for a too long time (par.177), once the current rated value is reached, it is kept constant.

If button **PDL** is kept depressed for a given time, the voltage reference slowly drops following the ramp set in parameter P034 and unloading the material in excess (*partial demagnetisation*).

If button **PDL** is longer kept pressed, the converter shuts off and output voltage drops to zero; to set again the desired voltage, just release button PDL.

Even if the voltage reference returns to its initial value without following any preset ramp, current will rise slowly because the *boost* function is inactive.

If deenergizing button **PD** is pressed, relay **RE** deenergizes, and digital inputs *MDI 5* (terminal 36) and *MDI 6* (terminal 3) are activated: input voltage reference for terminal 5 is then switched to an internal current reference equal to the max. negative value.

This occurs with the maximum negative voltage that the converter can deliver; with the default value of par. P231 (*AlfaMax*) this is equal to $V = V_{SUPPLY} \cdot 1.36 \cdot \cos \alpha Max$ (approx. $-470V_{DC}$ with $400V_{AC}$). The *boost* function enables, which considerably reduces current fall time.

As soon as current drops to zero, relay **RC** energizes, self-maintaining. Then, once current conduction switches from bridge A to bridge B, current becomes negative.

Bridge B is set to current limit due to the low value set through potentiometer **PI** and sent to auxiliary input *AnIn 1*, which is configured as current limit for bridge B through parameter C120. Its incoming signal is weakened by parameter P128 to exploit the whole scale of the potentiometer.

Current is kept constant for the time set in parameter P195 (residual magnetization is suppressed); when the time set in P195 is over, contact of digital output *MDO 5* closes (*MDO 5* is set as "current limit attained" by default) and relay **RF** is energized, self-maintaining.

Contact NC of **RF** on terminal 24 of *ENABLE* opens (stand-by command), so current is forced to zero with the max. positive voltage available applied to the magnet (approx. $+470V_{DC}$ with $400V_{AC}$).

When voltage and current cancel out, the converter is really disabled; contact *MDO 4* opens and turns off indicator light **LMA**.

As soon as current drops below the current threshold, relay **RI** deenergizes, thus allowing to send a new energizing command.

When button **PE** is pressed again, self-maintenance is disabled for relays **RA**, **RC**, **RF**, and the operating cycle can start again.

NOTE: What explained in the section above concerns loads consisting in only one electromagnet (or in a fixed number of electromagnets) and loads consisting in a variable number of electromagnets, e.g. multiple parallel-connected electromagnets, some of which can be disabled.

If a variable number of electromagnets is used, you must decrease time by time the value of parameter C000 down to the sum of rated currents of operated magnets, in order to make sure that the current for each electromagnet never exceeds both forward value during initial *boost* operation and reverse value during final counter-energizing.

6.10.5 DCREG2 ELECTROMECHANICAL DIAGRAM FOR REFERENCE SWITCHING

The diagram in Figure 5 illustrates how commands and references are managed both for magnetization and for demagnetisation. Using a DCREG2, the phase of counter-energizing, which is essential to suppress residual magnetization, is no more available.
If relays are used instead of a PLC, relays controlled by DCREG2's digital outputs may be equipped with AC or DC coils, provided that the maximum allowable power value is not exceeded. Because of weak current values (milliAmperes), use low capacity relays to make sure that contacts properly close.

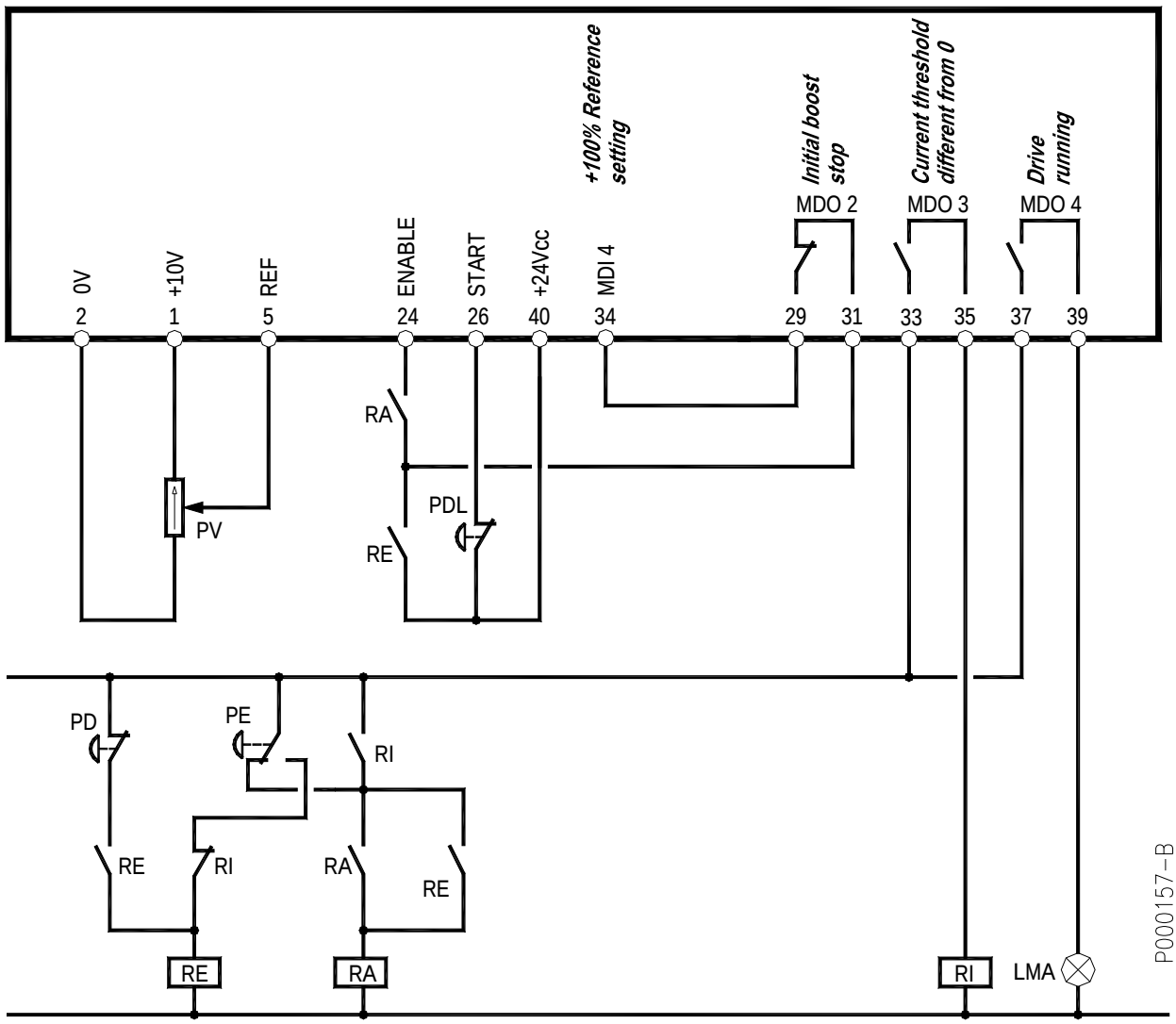


FIG. 5

LEGEND

LMA: Indicator light, magnet on
PD: Button, magnet deenergizing
PDL: Button, magnet partial deenergizing
PE: Button, magnet energizing
PV: Potentiometer, energizing voltage
RA: Relay, converter enabling
RE: Relay, storage of energizing/deenergizing commands
RI: Relay, current in the magnet "on"

6.10.6 DCREG2 SETTING PARAMETER VALUES DIFFERENT FROM DEFAULT VALUES

P003 = 1	*Advanced programming level*
P011 = 1.15 x $V_{MAINSnom}$	***Boost DC voltage** forcing energizing current*
P031 = 10 s	*Down ramp time of positive voltage reference*
P034 = 60 s (example)	***Down ramp during partial demagnetisation***
P059 = 0.01 %/µs	*Ramp over current reference*
P070 = 1	*Proportional gain kp of voltage regulator*
P071 = 0.1 s	*Integral time Ti of voltage regulator*
P100 = 1.5	*Proportional gain kp of current regulator*
P101 = 10 ms	*Integral time Ti of current regulator (discontinuous operation)*
P102 = 100 ms	*Integral time Ti of current regulator (continuous operation)*
P122 = $\frac{V_{nom}}{P011} \cdot 100$	*Gain over REF for **magnet rated voltage** as a percentage of boost voltage*
P176 = 5	*Digital output MDO 2 set as Drive Running*
P177 = 3 s (example)	*Digital output MDO 2 enabling delay for **starting boost duration** setting*
P181 = 1	*Digital output MDO 2 set up with normally closed logic*
P185 = 5%	*Current threshold for digital output MDO 3 as a perc. of $I_{DRIVEnom}$*
P211 = +100%	*PresetSpd 1 for boost upon energizing*
P230 = 30°	*Minimum delay angle*
C000 = $\frac{I_{EM\ nom}}{I_{DRIVE\ nom}} \cdot 100$	***Magnet rated current** expressed as a percentage of the converter size*
C030 = $V_{MAINSnom}$	***Three-phase, rated supply voltage** for the converter*
C070 = 4	*Armature feedback*
C150 = 1	*Alarm A001 trip disabled (Field current failure)*
C151 = 1	*Alarm A004 cleared (Load loss)*
C153 = 1	*Alarm A006 trip disabled (Unstable mains frequency)*
C154 = 1	*Alarm A007 trip disabled (No supply phase)*
C156 = 1	*Alarm A010 trip disabled (Output over voltage)*
C157 = 1	*Alarm A016/17 trip disabled (Tolerance exceeded by mains voltage)*
C170 = 1	***Selection of inductive load***

NOTES

1. Set **P000 = 1** to alter the parameters above.
2. **Save** all changes made to the parameters above. The remaining parameters are expected to be left at their default values (factory setting).
3. If an oscilloscope is used to monitor the response to a current reference step, temporarily change the value of parameter **C133** from 1: *Preset Speed A* (default value) to **6: *Slave Enabled***. If so, the reference set on potentiometer PV (that must not be set at its max. value to avoid current limit) becomes a current reference, for the time set in P177. The current waveform may be read on terminal 8 by setting par. **P150** to **9: *ArmatureCurr***

6.10.7 DCREG2 OPERATION DESCRIPTION

If button **PE** is pressed, relay **RE** energizes, self-maintaining. When **PE** returns to its initial position, relay **RA** energizes as well, self-maintaining. As a consequence, the series of two contacts on terminal 24 for *ENABLE* closes and the converter starts delivering output voltage. Indicator light **LMA** comes on to indicate that the magnet is on.

Closed contact of digital output *MDO 2* keeps digital input *MDI 4* active on terminal 34 for the time set in P177; DC output voltage is set (with par. P011 and P211), which is equal to mains 3-phase voltage increased by 15% (e.g. $460V_{DC}$ with $400V_{AC}$).

Max. positive voltage which may be delivered by the converter with the value of 30° in par. P230 (*AlfaMin*) is equal to $V = V_{SUPPLY} \cdot 1.36 \cdot \cos \alpha Min$ (approx. $+470V_{DC}$ with $400V_{AC}$).

Then, the *boost* function activates, which considerably reduces the current rise time. Current will reach the magnet rated value set in C000 within a given time. Even though the max. voltage reference is kept set for a longer time (par. P177), voltage delivered to the magnet terminal will drop anyhow (converter in current limit). If a variable number of electromagnets is used, you must decrease time by time the value of parameter C000 down to the sum of rated currents of operated magnets.

As soon as current is other than zero, *MDO 3* contact closes, thus energizing relay **RI**. If energizing button **PE** is pressed at any moment, the duty cycle of the equipment is not affected, thanks to contact NO of **RI** parallel-connected to contact NC of button **PE** and to contact NC of **RI**, which is series-connected to contact NO of button **PE**.

When the time set in par. P177 is over, contact *MDO 2* opens, and the reference becomes the magnet rated voltage set in potentiometer **PV**, whose full-scale value is set in par. P122.

Switching from the max. voltage reference to the rated reference of the magnet, current drops, due to a larger resistance of the electromagnet winding when this heats up. Otherwise, if *boost* is set for a too long time (par.177), once the current rated value is reached, it is kept constant.

If button **PDL** is kept depressed for a given time, the voltage reference slowly drops following the ramp set in parameter P034 and unloading the material in excess (*partial demagnetisation*). If button **PDL** is longer kept pressed, the converter shuts off and output voltage drops to zero; to set again the desired voltage, just release button PDL. Even if the voltage reference returns to its initial value without following any preset ramp, current will rise slowly because the *boost* function is inactive.

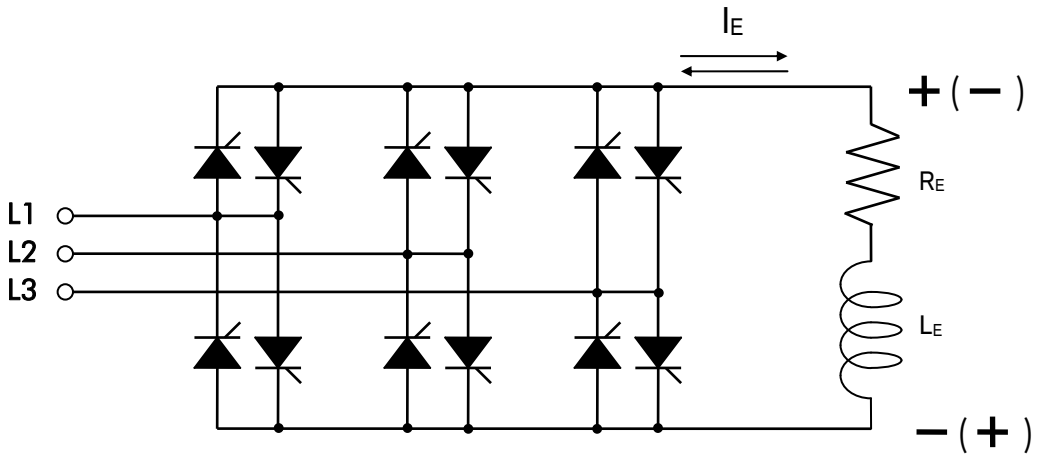
If deenergizing button **PD** is pressed, relay **RE** deenergizes: this will cause opening the series of two contacts on terminal 24 for *ENABLE*, setting stand-by command. As a consequence, input voltage reference for terminal 5 is then switched to a current reference equal to zero.

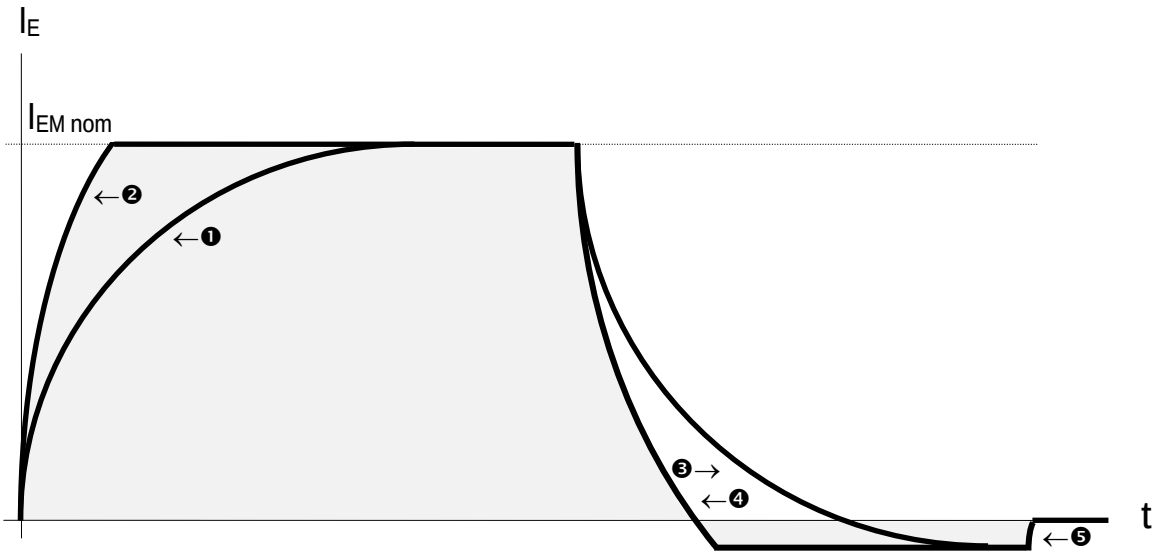
Fall down to this value is performed with the maximum negative voltage that the converter can deliver; with the default value of par. P231 (*AlfaMax*) this is equal to $V = V_{SUPPLY} \cdot 1.36 \cdot \cos \alpha Max$ (approx. $-470V_{DC}$ with $400V_{AC}$). The *boost* function enables, which considerably reduces current fall time.

When voltage and current cancel out, the converter is really disabled; contact *MDO 4* opens and turns off indicator light **LMA**.

As soon as current drops below the current threshold, relay **RI** deenergizes, thus allowing to send a new energizing command.
When button **PE** is pressed again, self-maintenance is disabled for relay **RA**, and the operating cycle can start again.

6.10.8 ENERGIZING/DEENERGIZING CURRENT PATTERNS





Electromagnet energizing:

❶ Rated voltage positive reference
❷ Rated current positive reference, i.e. max. voltage positive reference (ª)

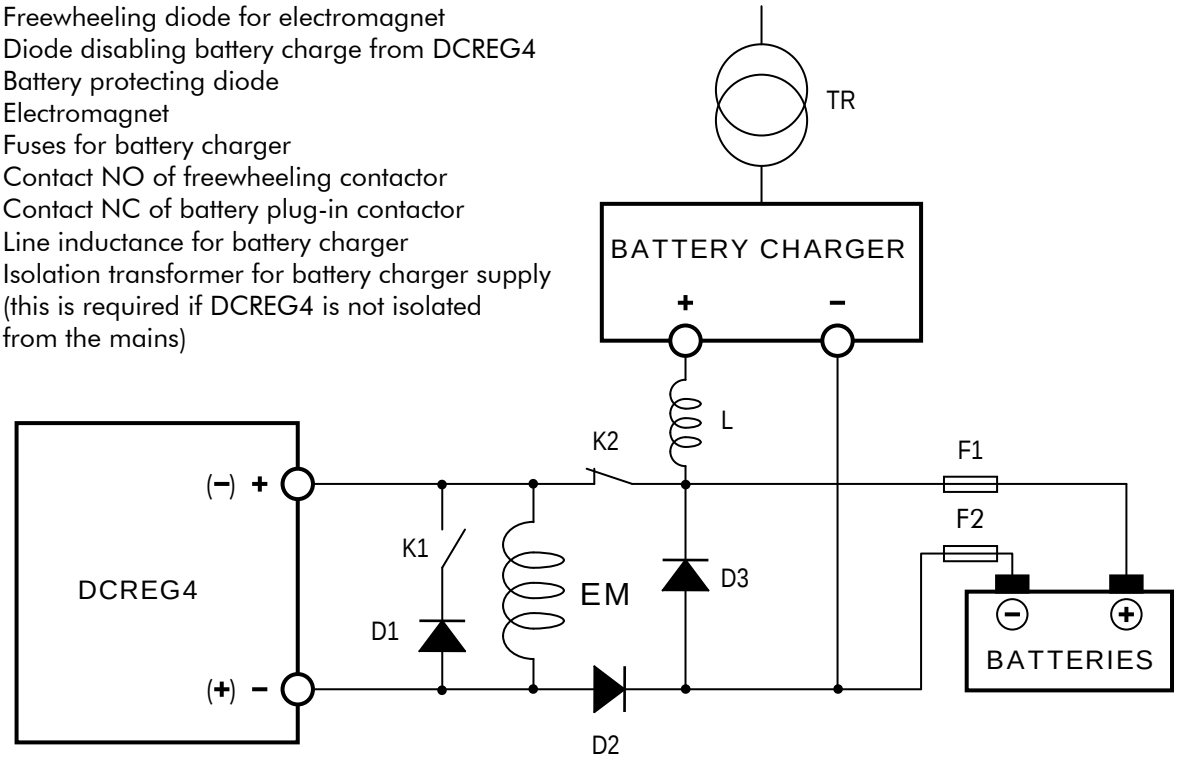
Electromagnet deenergizing and suppression of residual magnetization:

❸ Voltage negative reference
❹ Current negative reference, i.e. max. voltage negative reference (ᵇ)
❺ Zero current reference (*Enable* contact open) (ª)

(ª) Positive voltage limited to firing angle "α_{motor}"
(ᵇ) Negative voltage limited to firing angle "α_{brake}"

6.10.9 OPERATION WITH SAFE BATTERIES

D1: Freewheeling diode for electromagnet
D2: Diode disabling battery charge from DCREG4
D3: Battery protecting diode
EM: Electromagnet
F1-2: Fuses for battery charger
K1: Contact NO of freewheeling contactor
K2: Contact NC of battery plug-in contactor
L: Line inductance for battery charger
TR: Isolation transformer for battery charger supply (this is required if DCREG4 is not isolated from the mains)



OPERATION SEQUENCE

For safety reasons, coil in contactor K2 voltage is derived from the mains, with normally closed power poles.

When supply mains is on, poles are open.

When voltage is removed, poles of contactors K1 and K2 must instantly close. Battery supply is then delivered to the electromagnet.

When the converter comes on again, external contacts and the DCREG4 reference must be capable of starting it up immediately (electromagnet energizing with a properly large voltage reference). If no alarm trips, an external **timer** must be enabled. When its counting is over and the DCREG4 is adjusting a voltage value higher than the voltage supplied to the batteries (see section below), freewheeling diode and reserve batteries may be disconnected. Poles of contactors K1 and K2 open again.

If voltage is removed while deenergizing (i.e. after pressing button PD), batteries shall **not** activate, because if counter-energizing has already started, DCREG4 output should be short-circuited from diode D1.

NOTE 1. Diodes D1...3 are to be dimensioned for a current value equal to the electromagnet current and for inverse voltage equal to 1600V, provided that DCREG4 3-phase supply does not exceed 440V.
NOTE 2. Current used to charge safe batteries can be equal to 10% of their capacity in Ah, for a time period of approx. 10h.

6.10.10 ALARMS

If a failure is detected, an alarm trips and stops the converter. Default setting of digital output *MDO 1* is *0:Drive OK*.

Two conditions may occur:
1) After 0.5 s, the alarm tripped is stored to E^2PROM.
2) The alarm tripped is NOT stored to E^2PROM (e.g. failure of one or more supply phases).

If the alarm tripped is stored to E^2PROM and the cause responsible for the alarm has disappeared, send a **reset** command to terminal **28** (*MDI 1*), which is factory-set to *0:Reset*.

If the alarm is not stored to E^2PROM (failure of one or more supply phases), when mains supply comes on again and if the *ENABLE* contact is still closed, the converter is self-reset, but will be able to restart only after 10s from the instant when power is restored. This is a safety delay set in par. C101 (*PwrOn Time*) (factory-setting: 10s).

The safety delay is enabled only for the first start-up after a power failure.
If safe batteries are installed, which activate in case of power failure, the time set in the external timer must be longer than 10s.

Safe battery voltage can be higher (at least in a first stage) than the magnet rated voltage; also, voltage set in the potentiometer can be accidentally too low. Make sure that the voltage regulated by the converter is **higher** than the battery voltage when batteries are on and the converter is operating again; if not, the converter will tend to discharge safe batteries. To do so, contact between terminals 29 and 31 (*MDO 2*) must be kept closed for the required time period.

7 OPERATION PARAMETERS

7.1 MEASURE PARAMETERS

The measure parameters are the display parameters marked with an **M** followed by the parameter number.
The following symbols have been used to describe the above mentioned parameters and any other parameters afterwards stated.

Keys to the symbols used:

P : Parameter number

R : Range of the allowable values

D : Factory setting

F : Function

7.1.1 M000: REFERENCE APPLIED TO THE RAMPS

M000 Vreference		
Vref ***** %	**P**	M000 - Vref
	R	-150. ... +150. %
	F	If the drive is on (*RUN* LED on), this parameter corresponds - as a value per cent of the max. reference corresponding to 10V - to the *Ref n* reference applied to the ramps. Otherwise (if the *ENABLE* digital input is inactive), this parameter indicates the reference that is likely to be applied to the ramps when the drive is running - once this input is enabled and without changing the current state of the *START*, *PRESET SPEED* and *JOG* inputs (according to the logic stated in the table contained in the BLOCK DIAGRAM). The reference obtained is either a speed / voltage reference or a current reference, should the *6:Slave* function (see parameters C130 ... C135) be enabled through a digital input. The value per cent displayed in this parameter - either as a speed / voltage reference or a current reference -keeps track of the *Reverse* function applied to the reference selected to be displayed in this parameter, i.e. *Main Ref*, *Preset Ref* or *Jog Ref*. The value contained in this parameter is displayed also in the first line on the *Keypad* page, while the other measure parameters selected through par. P005 (*FirstParm*) and P006 (*MeasureSel*) may be contained in the lower line.

7.1.2 M001: SPEED / VOLTAGE FEEDBACK

M001 SpeedFdbk		
nFdbk ***** %	**P**	M001 - nFdbk
	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. feedback corresponding to 10V, the value of the overall *n setpoint* (resulting from the algebraic sum of all applied references) with armature compensation (P086, P088) correction (if any) and offset (P087) correction (if any). In case of a tacho feedback or an encoder feedback, 100% of such value corresponds to the max. speed set through parameter P010. In case of an armature feedback, 100% of such value corresponds to the max. voltage set through parameter P011.

7.1.3 M002: Overall Speed/Voltage Reference

From SW Vers. D3.09

M002 nSetPoint		
nSetP ***** %	P	M002 - nSetP
	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the overall speed / voltage reference *n setpoint* which is applied time after time. This reference is compared - when summed up to the armature compensation (P086, P088) correction (if any) and the offset (P087) correction - to the feedback value displayed for par. M001 *(nFdbk)*.

Up to SW Vers D3.07

M002 SpeedError		
Verr ***** %	P	M002 - Verr
	R	-200. ... 200. %
	F	This parameter indicates, as a percentage of the max. error corresponding to 10V, the difference between the speed / voltage overall reference *n setpoint* - with armature compensation (P086, P088) correction (if any) and offset (P087) correction (if any)- and the feedback quantity (tacho, encoder or armature voltage). For instance, if only the *REF* main reference applied to the ramps is used (with no additional references), then M002 = M000 - M001 at steady state.

7.1.4 M003: Armature Current Reference

M003 ArmCurrRef		
Iref ***** %	P	M003 - Iref
	R	-150. ... 150. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to the drive rated current, the current loop input (corresponding to the speed / voltage loop output) eventually limited by one or more relevant parameters (see parameter C000 and parameter set P050 ... P062, in case of internal limit). For instance, for a DCREG.100, 100% of M003 will correspond to 100A.

7.1.5 M004: Armature Current

M004 ArmCurrent		
Iarm ***** Amps	P	M004 - Iarm
	R	-5250 ... 5250 Amps
	F	This parameter indicates, in Amperes, the mean value of the armature current feedback, which is obtained through the current transformers.

7.1.6 M005: Thyristor Firing Delay Angle

M005 FiringDelay		
Alfa **** °	P	M005 - Alfa
	R	P230 ... P231
	F	This parameter indicates, in electrical degrees, the delay angle of the thyristor firing pulses. Such angle results from the intersections of the three-phase line voltages.

7.1.7 M006: ARMATURE VOLTAGE

M006 ArmatureV	P	M006 - Varm
Varm ***** V	R	-1000 ... 1000 V
	F	This parameter indicates, in Volts, the voltage across the motor armature circuit. Such voltage is directly measured at the drive output.

7.1.8 M007: BACK-ELECTROMOTIVE FORCE

M007 BackEMF	P	M007 - BEMF
BEMF ***** V	R	-1000 ... 1000 V
	F	This parameter indicates, in Volts, the back-electromotive force generated by the motor. Such voltage is internally calculated using the motor electric ratings. If the current loop operation has been programmed by setting parameter C051 to *0:PI operating*, this parameter will not be calculated.

7.1.9 M008: MAINS FREQUENCY

M008 MainsFreq	P	M008 - Frequency
MFreq **** Hz	R	40.0 ... 70.0 Hz (normally displayed range)
	F	This parameter indicates, in Hertz, the power supply mains frequency measured on the input bars.

7.1.10 M009: MAINS VOLTAGE

M009 MainsV	P	M009 - Vmains
Vmains **** V	R	0 ... 1000 V
	F	This parameter indicates, in Volts, the mains voltage applied to the drive power section.

7.1.11 M010: AUXILIARY ANALOG INPUT 1 TO TERMINALS 11 AND 13

M010 AnalogIn1	P	M010 - AnIn1
AnIn1 ***** %	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the value of the reference resulting from *IN 1* reference application between terminals 11 and 13. The reference obtained may be configured through parameter C120. The value per cent displayed in this parameter takes account of the *Gain*, *Bias*, *Polarity*blocks (see parameters P128, P127 and P126 respectively) and of the *Reverse* function which are applied in the above-mentioned order. The value per cent displayed in this parameter also displays the reference issued from a current external signal (milliAmperes), provided that jumper JP8 on terminal board ES801 (JP408 in ES906) is set on position 2-3: if an analog input is to be used as a **0(4) ... 20mA signal**, the value to be set on the parameters relating to *Gain* and *Bias* operators is shown in the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.

7.1.12 M011: Auxiliary Analog Input 2 on Terminal 17

M011 AnalogIn2	P	M011 - AnIn2
AnIn2 ***** %	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the value of the reference resulting from *IN 2* reference application between terminal 17 and 0V. The reference obtained may be configured through parameter C121. The value per cent displayed in this parameter takes account of the *Gain*, *Bias* and *Polarity* blocks (see parameters P131, P130 and P129 respectively) and of the *Reverse* function - only if an input is configured as a speed additional reference - applied in the above-mentioned order.

7.1.13 M012: Auxiliary Analog Input 3 on Terminal

M012 AnalogIn3	P	M012 - AnIn3
AnIn3 ***** %	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the value of the reference resulting from *IN 3* reference application between terminal 19 and 0V. The reference obtained may be configured through parameter C122. The value per cent displayed in this parameter takes account of the *Gain*, *Bias and Polarity* blocks (see parameters P134, P133 and P132 respectively) and of the *Reverse* function - only if an input is configured as a speed additional reference - applied in the above-mentioned order.

7.1.14 M013: Up/Down Internal Reference

M013 UpDownref	P	M013 - UpDnRef
UpDnRef ***** %	R	-100 ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the value of the reference assigned to the Up/Down internal variable.

7.1.15 M014: Main Analog Input to Terminals 5 and 7

M014 TermRef		
TermRef ***** %	P	M014 - TermRef
	R	-100 ... 100. %
	F	This parameter indicates, as a percentage of the max. reference corresponding to 10V, the value of the reference resulting from the application of the *REF* main analog input between terminals 5 and 7. The reference obtained is either a speed / voltage reference or a current reference if the *6:Slave* function is entered through a digital input (see par. C130 ... C135). The value per cent displayed in this parameter, either as a speed / voltage reference or a current reference, considers the *Gain*, *Bias* and *Polarity* blocks (see par. P122, P121 and P120, or par. P125, P124 and P123 respectively for the two types of references) applied in the above-mentioned order. For example, if a motor rotates at 2000 RPM with a 10V reference and if P122 = 100%, then with a 10V reference and if P122 = 25% the motor will rotate at 500 RPM (the display will show M014 = 25% and M001 = 25%); otherwise, with a 2.5V reference and if P122 = 200%, the motor will rotate at 1000 RPM (the display will show M014 = 50% and M001 = 50%). The value per cent displayed in this parameter also indicates the reference obtained from a current external signal (milliAmpere) if jumper JP7 in ES801 (JP407 in ES906) is set in pos. 2-3: if the user intends to use an analog input as a **0(4) ... 20mA signal**, the value to program in the parameters relating to the *Gain* and *Bias* operators is stated in the INPUT / OUTPUT SIGNAL IN MILLIAMPERE chapter.

7.1.16 M015: Serial Connection Reference

M015 SLinkRef		
SLRef ***** %	P	M015 - SLRef
	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. value corresponding to 10V, the value of the reference applied through serial connection.

7.1.17 M016: Field Bus Reference

M016 FBusRef		
FBRef ***** %	P	M016 - FBRef
	R	-100. ... 100. %
	F	This parameter indicates, as a percentage of the max. value corresponding to 10V, the value of the reference applied through the field bus.

7.1.18 M017: Field Current Reference

M017 FldCurrRef		
RefFld **** %	P	M017 - RefFld
	R	0.00 ... 100. %
	F	It indicates, as a percentage of the max. reference corresponding to the max. field current that may be generated by the drive, the current loop input (corresponding to the voltage loop output) of the internal field regulator. The standard values of the max. field current generated by the drive are equal to 5A for DCREG.100max, 15A for DCREG.150min Size 1, and 35A for DCREG Size 2(A) and MODULAR.S. For instance, for a DCREG.350, 100% of M017 will correspond to 15A.

7.1.19 M018: Field Current

M018 FldCurrent		
Ifld **** Amps	P	M018 - Ifld
	R	0.00 ... 40.0 Amps
	F	This parameter indicates, in Amperes, the field current feedback value obtained through the zero gauss current transformer.

7.1.20 M019: Analog Output 1 on Terminal 8

M019 AnalogOut1		
AnOut1 ***** V	P	M019 - AnOut1
	R	-10.0 ... +10.0 V
	F	This parameter indicates, in Volts, the value of the analog output available on terminal 8. The output at issue may be configured through parameter P150. The value per cent displayed in this parameter considers the *Gain*, *Bias* and *Polarity* operators set through parameters P152, P151 and P157 respectively.

7.1.21 M020: Analog Output 2 on Terminal 10

M020 AnalogOut2		
AnOut2 ***** V	P	M020 - AnOut2
	R	-10.0 ... +10.0 V
	F	This parameter indicates, in Volts, the value of the analog output available on terminal 10. The output at issue may be configured through parameter P153. The value per cent displayed in this parameter considers the *Gain, Bias* and *Polarity* operators set through parameters P155, P154 and P158 respectively.

7.1.22 M021: Final Internal State of Digital Inputs

M021 E S 1 2 3 4 5 6		
DigIn ■■■■□■□□	P	M021 - DigIn
	R	■ ... □ (the figure shows a display example for each input)
	F	This parameter displays the final internal state of the *ENABLE* and *START* digital inputs and of *MDIx* digital inputs that can be configured through par. C130 ... C135. The final internal state results from the combination of commands sent from the sources enabled with par. C110 ... C112 (*SeqSelx*), selected through terminals, serial connection or field bus. Particularly, for the *ENABLE* input, the signals' AND is considered (this input is active only if all inputs are active and if **the *ENABLE* contact is closed on terminal 24**). For the remaining seven inputs, the signals' OR is considered (at least one of the inputs must be active). A small black square indicates that the digital input is active. The ID-digital input matching is the following: **E** → **ENABLE** input logical state. **S** → **START** input logical state. **1** → **MDI1** input logical state. **2** → **MDI2** input logical state. **3** → **MDI3** input logical state. **4** → **MDI4** input logical state. **5** → **MDI5** input logical state. **6** → **MDI6** input logical state.

7.1.23 M022: Digital Output State

M022 1 2 3 4 5	P	M022 - MDO
MDO ■□■□□	R	■ ... □ (the figure shows a display example for each output)
	F	This parameter displays the state of the available *MDOx* digital outputs, that may be configured through parameters P170 ... P199. A small black square indicates that the digital output is closed. The output terminal states are the following: **1** → state of the contact corresponding to output **MDO1** (terminals **25-27**). **2** → state of the contact corresponding to output **MDO2** (terminals **29-31**). **3** → state of the contact corresponding to output **MDO3** (terminals **33-35**). **4** → state of the contact corresponding to output **MDO4** (terminals **37-39**). **5** → state of the contact corresponding to output **MDO5** (terminals **41-43**).

7.1.24 M023: Field Regulator Internal Digital Input State

M023 RUN > 55 Hz	P	M023 - FldReg
FldReg ■ □	R	■ ... □ (the figure shows a display example for each output)
	F	Displays the state of the two inner digital inputs of the field regulator. A black square indicates that the digital input is active, i.e. the relating terminal on the field regulator is connected to 0V.

7.1.25 M024: Output Power

M024 OutputPower	P	M024 – POut
Pout **** kW	R	0 ... 5250 kW
	F	This parameter indicates, in kW, the power supplied to the load, as a division by 1000 of the output voltage product (par. M006) for the output current (par. M004).

7.1.26 M025: Motor Torque

M025 MotorTorque	P	M025 – Torque
Torque **** %	R	-180. ... 180. %
	F	It displays, as a percentage of the motor nominal torque, the motor torque as a product per cent of the armature current by the field current. 100% of this parameter is obtained with the motor armature nominal current (set by par. C000) and the motor field nominal current (set by par. C010).

7.1.27 M026: Encoder Frequency

M026 EncoderFreq	P	M026 – EFreq
EFreq ****** kHz	R	-102.4 ... 102.4 kHz
	F	This parameter displays, in kHz, the frequency of the encoder used as a speed feedback.

7.1.28 M027: DRIVE LIFE

M027 Drivelife	P	M027 – Drivelife
*****h **m	R	0 ... 235926000 s (approx. 7 years and a half), size ..h ..m
	F	This parameter indicates the drive overall operation time starting from its first power-on. This value is stored each time the power section is shut off.

7.1.29 M028: PHASESEQ

M028 PhaseSeq	P	M028 – PhaseSeq
* * *	R	RST ... TSR
	F	Indicates which is the phase sequence supplying the drive section power with reference to bars L1-L2-L3 respectively.

7.1.30 M029: DIGITAL INPUT STATE FROM TERMINAL BOARD

M029 E S 1 2 3 4 5 6	P	M029 - TrmDgIn
TrmDgIn ■■■■□■□□	R	■ ... □ (the figure shows a display example for each input)
	F	This parameter displays the state (in the terminal board) of the *ENABLE* and *START* digital inputs and of the *MDIx* digital inputs configured through par. C130 ... C135. A small black square indicates that the digital input is active, i.e. that the relevant terminal is connected to + 24V. The ID-input terminal matching is the following: **E** → **ENABLE** input logical state (terminal **24**). **S** → **START** input logical state (terminal **26**). **1** → **MDI1** input logical state (terminal **28**). **2** → **MDI2** input logical state (terminal **30**). **3** → **MDI3** input logical state (terminal **32**). **4** → **MDI4** input logical state (terminal **34**). **5** → **MDI5** input logical state (terminal **36**). **6** → **MDI6** input logical state (terminal **38**).

7.1.31 M030: Digital Input State from Serial Connection

M030 E S 1 2 3 4 5 6	P	M030 - SLDgIn
SLDgIn ■■■■□■□□	R	■ ... □ (the figure shows a display example for each input)
	F	This parameter displays the state (from serial connection) of the *ENABLE* and *START* digital inputs, and of the *MDIx* digital inputs that can be configured through parameter C130 ... C135. A small black square indicates that the digital input is active. The ID-digital input matching is the following: **E** → **ENABLE** input logical state. **S** → **START** input logical state. **1** → **MDI1** input logical state. **2** → **MDI2** input logical state. **3** → **MDI3** input logical state. **4** → **MDI4** input logical state. **5** → **MDI5** input logical state. **6** → **MDI6** input logical state.

7.1.32 M031: Digital Input State from Bus Field

M031 E S 1 2 3 4 5 6	P	M031 - FBDgIn
FBDgIn ■■■■□■□□	R	■ ... □ (the figure shows a display example for each input)
	F	This parameter displays the state (from bus field) of the *ENABLE* and *START* digital inputs, and of the *MDIx* digital inputs that can be configured through parameters C130 ... C135. A small black square indicates that the digital input is active. The ID-digital input matching is the following: **E** → **ENABLE** input logical state. **S** → **START** input logical state. **1** → **MDI1** input logical state. **2** → **MDI2** input logical state. **3** → **MDI3** input logical state. **4** → **MDI4** input logical state. **5** → **MDI5** input logical state. **6** → **MDI6** input logical state.

7.2 PROGRAMMING PARAMETERS

The value of the programming parameters may be fixed by the user even during the drive operation. These parameters are marked with a **P** followed by the parameter number.

7.2.1 P000: PROGRAMMING CODE

P000 Key		P000 - Key
***	R	0 ... 2
	D	0
	F	Programming access code. **0:Program Disable.** Only P000 may be changed. **1:Program Enable.** All parameters may be changed (for *Cxxx* parameters, the *ENABLE* digital input is not to be active). **2:Modified Parms**. As for parameters *Pxxx* and *Cxxx*, only the parameters whose actual value is different from the default value are displayed, along with all the *Mxxx* measure parameters. The programming mode will also be activated, according to the results obtained by setting parameter P000 = 1. Even though par. P003 (*ProgLevel*) is set at *0:Basic*, all the *Pxxx* and *Cxxx* parameters whose current value is different from the default value are displayed.

WARNING For this parameter, no values other than *0:ProgramDisable* may be stored on EEPROM.

7.2.2 P001: AUTOTUNING COMMAND

P001 AutoTune		P001 – AutoTune
***	R	0 ... 3
	D	0
	F	Access code for autotuning. **0:Disabled**. No autotune is performed. **1:Current**. The current loop autotuning is performed by choosing a predictive control through par. C051 (*CurrLoopSel*) to *1:Predictive=>J1*, it computes the value for par. P103, P104. The parameter relating to the armature feedback reading is optimised so that par. M006 (*Varm*) displays 0V when the drive is on. **Before performing current autotune, set jumper J1 from position 1 to position 0. Jumper J1 is located on board ES729/1 (installed inside the equipment on control board ES728/2).** **2:Speed**. The speed loop autotuning is performed and par. P070, P071 or P076, P077 are computed if the digital input is closed by configuring one of par. C130 ... C135 as *8:SecondParmSet*. **3:RxI**. The armature resistive drop measure is performed. The result is stored in par. P088 (*RxI*).The parameter value relating to the armature feedback reading is optimised, so that par. M006 (*Varm*) displays 0V when the drive is off.

WARNING For this parameter, no values other than *0:Disabled* may be stored on EEPROM.

7.2.3 P002: PARAMETER COPY COMMAND

P002 ParmsCopy		
***	P	P002 – ParmsCopy
	R	0 … 3
	D	0
	F	Access code for the parameter copy. **0:Disabled**. No parameter copy command is sent. **1:DefaultRestore**. Restoration of the user's parameter default values. **2:WorkAreaBackup**. Backup of the current parameters. **3:Backup Restore**. Restoration of the backup parameters. See also the PARAMETER COPY chapter.

WARNING For this parameter, no values other than *0:Disabled* may be stored on EEPROM.

7.2.4 P003: PROGRAMMING LEVEL

P003 ProgLevel		
***	P	P003 – ProgLevel
	R	0 … 1
	D	0
	F	**0:Basic**. **1:Advanced**. Sets the programming level required, chosen between a fast starting base level with the basic functions and an advanced level for skilled users who want to optimise the equipment performance. If this parameter is programmed at *0:Basic*, only the following parameters may be accessed: M000 (*Vref*). Reference applied to the ramps. … M031 (*FBDgIn*). Digital input state from field bus. P000 (*Key*) P003 (*ProgLevel*) P010 (*nFdbkMax*) P011 (*VarmMax*) P030 (*RampUpPos*) P031 (*RampDnPos*) P032 (*RampUpNeg*) P033 (*RampDnNeg*) P034 (*RampStopPos*) P035 (*RampStopNeg*) P038 (*InitialRndg*) P039 (*FinalRndg*) P060 (*OverLimA*) P061 (*OverLimB*) P086 (*ArmatureCmp*) P087 (*VerrOffset*) C000 (*Inom*) C010 (*IfldNom*) C030 (*VmainsNom*) C051 (*CurrLoopSel*) C070 (*nFdbkSelect*) C072 (*EncoderPls*) C074 (*Tach Volts*) If this parameter is set at *1:Advanced*, all other parameters may be accessed.

7.2.5 P004: PAGE DISPLAYED AT POWER ON

P004 FirstPage		P004 – FirstPage
***	R	0 … 1
	D	0
	F	This parameter determines the page displayed when the control section is turned on. **0:Status**. The *Status* page is displayed at power on. **1:KeyPad**. The *KeyPad* page is displayed at power on.

7.2.6 P005: MEASURE PARAMETER DISPLAY ON THE KEYPAD PAGE

P005 FirstParm		P005 – FirstParm
***	R	M000 … M031 + "Select (→P006)"
	D	Select (→P006)
	F	If this parameter is assigned a value among the available *Mxxx* parameters, when pressing the "PROG" key the display will cycle through all measure parameters in the bottom line on the *Keypad* page starting from the selected one. If this parameter is kept at its default value, the parameters displayed in the bottom line on the *Keypad* page are the parameters defined in par. P006 (*MeasureSel*) only.

7.2.7 P006: MEASURE PARAMETER SELECTION ON THE KEYPAD PAGE

P006 MeasureSel		P006 – MeasureSel
***	R	* * * * * * * * … 3131313131313131
	D	* * * * * * * *
	F	If par. P005 (*FirstParm*) is assigned its default value, this parameter defines all measure parameters (max. 8 par.) that have to be cyclically displayed in the bottom line on the *Keypad* page (max. 8 parameters) when pressing the "PROG" key.

7.2.8 P010: MAX. SPEED

P010 nFdbkMax		P010 - nFdbkMax
**** RPM	R	300 … 6000 RPM
	D	2500 RPM
	F	It sets, in rpm, the max. speed the motor achieves in case of a tacho or encoder feedback when the speed reference is equal to 100%. In both cases, the constant of the transducer used is to be set. Use parameter C072 if the transducer is represented by the encoder; use parameter C074 if the transducer is represented by the tacho.

WARNING

In encoder feedback mode, the values set in par. C072 and in par. P010 have to ensure that product C072•P010 does **not exceed 102.400kHz** (e.g. 1024 pulse/rev per 6000 RPM max), whereas in tacho feedback mode the values set in par. C074 and par. P010 have to ensure that product C074•P010 does **not exceed 25V if C070 = 0, 80V if C070 = 1, 250V if C070 = 2**. Otherwise, this will cause drive speed control failure.

7.2.9 P011: MAX. ARMATURE VOLTAGE

P011 VarmMax		
*** V	P	P011 - VarmMax
	R	50 ... 2000V
	D	DCREG4: 400 V DCREG2: 460 V
	F	It sets, in Volts, the max. armature voltage the motor achieves in case of an armature feedback, when the voltage reference is equal to 100%.

WARNING

A software lock exists avoiding to decrease par. P011 value under the value set in par. P088 *(RxI)*.

WARNING

For this parameter, never save a parameter lower than the one saved in EEPROM for P088 in order to avoid the drive malfunction.

7.2.10 P012: SPEED / VOLTAGE REFERENCE POLARITY

P012 SpdDmndPo1		
***	P	P012 - SpdDmndPol
	R	0 ... 2
	D	0
	F	This parameter sets the allowable polarity both for the *Ref n* reference applied to the ramps and for the *n setpoint* global speed / voltage reference resulting from the algebraic sum of all the applied references. **0:Bipolar.** Bipolar reference. **1:Positive only.** Positive reference only. **2:Negative only.** Negative reference only. If you program a unipolar global reference, the possible reference of the opposite polarity will be shut and considered as equal to zero. This parameter has no effect either on the jog internal references, that may have a dual polarity with no min. values, or on the possible offset on the speed error set through parameter P087. In order to enter a positive (P014) or negative (P016) min. speed / voltage reference, you need to first program P012 = *1:Positive only* or P012 = *2:Negative only* respectively. In order to change P012 value, both parameters P014 and P016 are to be equal to zero.

WARNING

If a certain min. reference other than zero is saved in EEPROM (parameter P014 or P016), **in P012 do not save any value that does not match** the polarity of the said min. reference, as this will cause the drive malfunction.

7.2.11 P013: MAX. POSITIVE SPEED / VOLTAGE REFERENCE

P013 nMaxPos		
*** %	P	P013 - nMaxPos
	R	0 ... 100 %
	D	100 %
	F	This parameter sets, as a percentage of the max. reference corresponding to 10V, the max. allowable value both for the *Ref n* reference applied to the ramps and for the *n setpoint* global positive speed / voltage reference resulting from the algebraic sum of all the applied references. This parameter may be used to limit the speed set in the running direction at issue.

WARNING

In this parameter, do not save any lower value than the one saved in EEPROM for P014, as this will cause the drive malfunction.

7.2.12 P014: MIN. POSITIVE SPEED / VOLTAGE REFERENCE

P014 nMinPos		
*** %	P	P014 - nMinPos
	R	0 ... 100 %
	D	0 %
	F	This parameter sets, as a percentage of the max. reference corresponding to 10V, the min. allowable value both for the *Ref n* reference applied to the ramps and for the *n setpoint* global positive speed / voltage reference, even if no reference is applied or if negative references are applied. In this parameter, in order to enter a min. reference you need to program P012 = *1:Positive only* first. Anyway, disabling of minimum speed can be achieved by closing the digital input set to the *9:MinSpdDisabled* function (see parameter set C130 ... C135).

WARNING

In this parameter, do not save any value exceeding the one saved in EEPROM for P013, as this will cause the drive malfunction.

WARNING

If a value of P012 ≠ 1 is saved in EEPROM, **do not save any value other than zero for this parameter**, as this will cause the drive malfunction.

7.2.13 P015: MAX. NEGATIVE SPEED / VOLTAGE REFERENCE

P015 nMaxNeg		
**** %	P	P015 - nMaxNeg
	R	-100 ... 0 %
	D	-100 %
	F	This parameter sets, as a percentage of the max. reference corresponding to 10V, the max. allowable absolute value both for the *Ref n* reference applied to the ramps and for the *n setpoint* global negative speed / voltage reference resulting from the algebraic sum of all the applied references.

WARNING

In this parameter, do not save - as an absolute value - any value exceeding the one saved in EEPROM for P016, as this will cause the drive malfunction.
This parameter may be used to limit the speed set in the running direction at issue.

7.2.14 P016: MIN. NEGATIVE SPEED / VOLTAGE REFERENCE

P016 nMinNeg		
**** %	P	P016 - nMinNeg
	R	-100 ... 0 %
	D	0 %
	F	It sets, as a percentage of the max. reference corresponding to 10V, the min. absolute value allowed both for the *Ref n* reference applied to the ramps and for the *n setpoint* negative global speed / voltage reference, even if no reference is applied or if positive references are applied. In this parameter, in order to enter a min. reference you need to program P012 = *2:Negative only* first. Anyway, disabling of minimum speed can be achieved by closing the digital input set to the *9:MinSpdDisabled* function (see parameter set C130 ... C135).

WARNING

In this parameter, do not save - as an absolute value - any value exceeding the one saved in EEPROM for P015, as this will cause the drive malfunction.

WARNING

If a value of P012 ≠ 2 is saved in EEPROM, **do not save any value other than zero for this parameter**, as this will cause the drive malfunction.

7.2.15 P030: RISE RAMP OF THE POSITIVE REFERENCE

P030 RampUpPos		
***** sec	P	P030 - RampUpPos
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Rise ramp time, expressed in seconds, from 0% to 100% of the positive speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value. See also figure shown in the RAMPS OVER REFERENCE chapter. For both DCREG4 and DCREG2, the real speed ramp corresponds to the ramp set in this parameter as long as the drive is not in current limit mode.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.16 P031: FALL RAMP OF THE POSITIVE REFERENCE

P031 RampDnPos		
***** sec	P	P031 - RampDnPos
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Fall ramp time, expressed in seconds, from 100% to 0% of the positive speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value. See also figure shown in the RAMPS OVER REFERENCE chapter. For DCREG4, the real speed ramp corresponds to the ramp set in this parameter as long as the drive is not in current limit mode, whereas for DCREG2, the real speed ramp corresponds to the ramp set as soon as it exceeds the time required for the coast to stop stage.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.17 P032: RISE RAMP OF THE NEGATIVE REFERENCE

P032 RampUpNeg		
***** sec	P	P032 - RampUpNeg
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Rise ramp time, expressed in seconds, from 0% to 100% of the negative speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value. See also figure shown in the RAMPS OVER REFERENCE chapter. As for the real speed ramp, see relevant note stated in parameter P030.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.18 P033: FALL RAMP OF THE NEGATIVE REFERENCE

P033 RampDnNeg		
***** sec	P	P033 - RampDnNeg
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Fall ramp time, expressed in seconds, from 100% to 0% of the negative speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value. See also figure shown in the RAMPS OVER REFERENCE chapter. As for the real speed ramp, see relevant note stated in parameter P031.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.19 P034: STOP RAMP OF THE POSITIVE REFERENCE

P034 RampStopPos		
***** sec	P	P034 - RampStopPos
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Fall ramp time, expressed in seconds, from 100% to 0% of the positive speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value, due to the disabling of the *START* digital input. See also the figure shown in the RAMPS OVER REFERENCE chapter. In order to exactly respect the time set for the stop ramp, the time set in par. P031 is to be equal to at least 10% of the time set in P034. Such parameter sets a positive reference fall ramp to be enabled - through the disabling of the *START* input - instead of the main ramp defined in parameter P031. As for the real speed ramp, see relevant note stated in parameter P031.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.20 P035: STOP RAMP OF THE NEGATIVE REFERENCE

P035 RampStopNeg		
***** sec	P	P035 - RampStopNeg
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Fall ramp time, expressed in seconds, from 100% to 0% of the negative speed / voltage reference applied to the *Main Ref* or the *Preset Ref* (preset run reference), possibly limited at the minimum and/or maximum value, due to the disabling of the *START* digital input. See also figure shown in the RAMPS OVER REFERENCE chapter. In order to exactly respect the time set for the stop ramp, the time set in par. P033 is to be equal to at least 10% of the time set in P035. Such parameter sets a negative reference fall ramp to be enabled - through the disabling of the *START* input - instead of the main ramp defined in parameter P033. As for the real speed ramp, see relevant note stated in parameter P031.

NOTE This parameter setting cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.21 P036: RISE RAMP OF THE JOG REFERENCE

P036 RampUpJog		
***** sec	P	P036 - RampUpJog
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Rise ramp time, expressed in seconds, from 0% to 100% of the speed / voltage reference selected among the three items programmed on parameters P222 ... P224 and enabled if max. two preset digital inputs close, should some parameter among C130...C135 be set to *12:JogA* and *13:JogB*. The value programmed in this parameter is used for P221 = *2:Separate ramps*. As for the real speed ramp, see relevant note in parameter P030.

7.2.22 P037: FALL RAMP OF THE JOG REFERENCE

P037 RampDnJog		
***** sec	P	P037 - RampDnJog
	R	0.000 ... 300.0 s
	D	0.000 s
	F	Fall ramp time, expressed in seconds, from 100% to 0% of the speed / voltage reference selected among the three items set on parameters P222 ... P224, which is enabled if the value set in this parameter decreases or if max. two preset digital inputs open, should some parameter among C130 ... C135 be set to *12:JogA* and *13:JogB*. The value programmed in this parameter is used for P221 = *2:Separate ramps*. As for the real speed ramp, see relevant note in parameter P031.

7.2.23 P038: RAMP INITIAL ROUNDING

P038 InitialRndg		
*** sec	P	P038 - InitialRndg
	R	0.0 ... 10. s
	D	0.0 s
	F	This parameter sets, in seconds, the initial rounding of the ramps up and ramps down defined through parameters P030 ... P033. See also figure shown in the RAMPS OVER REFERENCE chapter.

NOTE

This parameter programming cannot be changed if a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.24 P039: RAMP FINAL ROUNDING

P039 FinalRndg		
*** sec	P	P039 - FinalRndg
	R	0.0 ... 10. s
	D	0.0 s
	F	This parameter sets, in seconds, the final rounding of the ramps up and ramps down defined through parameters P030 ... P033. See also figure shown in the RAMPS OVER REFERENCE chapter.

NOTE

This parameter programming cannot be changed in case a digital input configured for the *7:Ramps Disabled* function is closed.

7.2.25 P040: RAMP OF THE UP/DOWN INTERNAL REFERENCE

P040 UpDnRefRamp		
***** sec	P	P040 - UpDnRefRamp
	R	.1000 ... 100. s
	D	10.00 s
	F	This parameter sets the time variation (in seconds), both for the rise ramp and the fall ramp, from 0% to 100% of the internal *UpDownRef* when the increase / decrease digital inputs are enabled. See also the MOTOR POTENTIOMETER chapter.

7.2.26 P050: BRIDGE A FIRST CURRENT LIMIT

P050 Ilim1A		
*** %	P	P050 - Ilim1A
	R	0 ... 300 %
	D	100 %
	F	This parameter sets the first current limit value relating to bridge A. Such value indicates the percentage of C000 motor rated current, eventually with the trimmer hardware limit (Imax[T2]). That limit is used if the speed is lower than the value set in P054. When M001 *(nFdbk)* speed is higher than the value set in P054, P052 limit is used. See also figure shown in the CURRENT LIMIT chapter.

WARNING

The product of P050•C000•IMAX[T2] is **not** to exceed 100%, that corresponds to the drive rated current (e.g. 100A for a DCREG.100).

7.2.27 P051: BRIDGE B FIRST CURRENT LIMIT

P051 Ilim1B		
*** %	P	P051 - Ilim1B (used in DCREG4 only)
	R	0 ... 300 %
	D	DCREG4: 100% DCREG2: 0% (not used)
	F	This parameter sets the first current limit value relating to bridge B. It is available in DCREG4 only. Such value indicates the percentage of C000 motor rated current, eventually with the trimmer hardware limit (IMAX[T2]). That limit is used if the speed is lower than the value set in P054. When M001 *(nFdbk)* speed is higher than the value set in P054, P052 limit is used. See also figure shown in the CURRENT LIMIT chapter.

WARNING

The product of P050•C000•IMAX[T2] is **not** to exceed 100%, that corresponds to the drive rated current (e.g. 100A for a DCREG.100).

7.2.28 P052: BRIDGE A SECOND CURRENT LIMIT

P052 Ilim2A		
*** %	P	P052 - Ilim2A
	R	0 ... 300 %
	D	100 %
	F	This parameter sets the second current limit value relating to bridge A. Such value indicates the percentage of C000 motor rated current, eventually with the trimmer hardware limit (IMAX[T2]). That limit is used if the speed is higher than the value set in P054. When M001 *(nFdbk)* speed is lower than the value set in P054, P050 limit is used. See also figure shown in the CURRENT LIMIT chapter.

WARNING

The product of P052•C000•IMAX[T2] is **not** to exceed 100%, that corresponds to the drive rated current (e.g. 100A for a DCREG.100).

7.2.29 P053: BRIDGE B SECOND CURRENT LIMIT

P053 Ilim2B		
*** %	P	P053 - Ilim2B (used in DCREG4 only)
	R	0 ... 300 %
	D	DCREG4: 100% DCREG2: 0% (not used)
	F	This parameter sets the second current limit value relating to bridge B. It is available in DCREG4 only. Such value indicates the percentage of C000 motor rated current, eventually with the trimmer hardware limit (IMAX[T2]). That limit is used if the speed is higher than the value set in P054. When M001 *(nFdbk)* speed is lower than the value set in P054, P051 limit is used. See also figure shown in the CURRENT LIMIT chapter.

WARNING

The product of P053•C000•IMAX[T2] is **not** to exceed 100%, that corresponds to the drive rated current (e.g. 100A for a DCREG4.100).

7.2.30 P054: First to Second Current Limit Speed

P054 Speed 1 → 2		
*** %	P	P054 - Speed 1 → 2
	R	0 ... 100 %
	D	100 %
	F	This is the speed, expressed as the value per cent set in P010 *(nFdbkMax)*, above which switching from the first to the second current limit value (from P050 to P052 or from P051 to P053, depending on the active bridge) occurs. See also figure shown in the CURRENT LIMIT chapter. This parameter is aimed at obtaining a two-value characteristic for the current limit.

7.2.31 P055: Hyperbolic Pattern End Current Limit

P055 IlimHyper		
*** %	P	P055 - IlimHyper
	R	0 ... 300 %
	D	100 %
	F	This parameter sets the current limit value at the end of the hyperbolic pattern. Such value indicates the percentage of C000 motor rated current eventually with thetrimmer hardware limit (IMAX[T2]). See also figure shown in the CURRENT LIMIT chapter.

7.2.32 P056: Hyperbolic Limit Start Speed

P056 SpeedHyper1		
*** %	P	P056 - SpeedHyper1
	R	0 ... 100 %
	D	100 %
	F	If this speed - expressed as a value per cent of P010 *(nFdbkMax)* - is exceeded, the current limit becomes a speed hyperbolic function. See also figure shown in the CURRENT LIMIT chapter.

WARNING **In this parameter, do not save any value exceeding** the one saved in EEPROM for P057, as this will cause the drive malfunction.

7.2.33 P057: Hyperbolic Limit End Speed

P057 SpeedHyper2		
*** %	P	P057 - SpeedHyper2
	R	0 ... 100 %
	D	100 %
	F	If this speed - expressed as a value per cent of P010 *(nFdbkMax)* - is exceeded, the current limit stops being a speed hyperbolic function and becomes constant again. See also figure shown in the CURRENT LIMIT chapter.

WARNING **In this parameter, do not save any value lower** than the one saved in EEPROM for P056, as this will cause the drive malfunction.

7.2.34 P058: CURRENT LIMIT DECREASE PER CENT

P058 Clim		
*** %	P	P058 - Clim
	R	0 ... 100 %
	D	50 %
	F	Current limit decrease per cent for both bridges following the configured digital input closing, as long as one parameter among C130 ... C135 is set to *4:Clim*. Such value is to be applied to the present current limit resulting from the composition of the values set in all relevant parameters (see parameter C000, parameter set P050 ... P062 - in case of internal limit - and trimmer hardware limit (IMAX[T2]) - if any).

7.2.35 P059: RAMP OVER THE CURRENT REFERENCE

P059 dI/dtMax		
*** %/µs	P	P059 - dI/dtMax
	R	.01 ... 1.0 %/µs
	D	.40 %/µs
	F	This parameter indicates the max. variation of the current reference in a microsecond; that variation is expressed as a percentage of the max. value (100%) corresponding to the drive rated current. This is the same as imposing - to the current reference - a min. rise ramp time from zero to 100% and a min. fall ramp time from 100% to zero. The time (expressed in milliseconds) corresponding to a particular value of such parameter results from the following formula: $t = \frac{1}{10 \cdot P059}$. E.g., the range of this parameter is equal to 0.1 ... 10ms with a 0.25ms default value.

7.2.36 P060: BRIDGE A CURRENT OVERLIMIT

P060 OverLimA		
*** %	P	P060 - OverLimA
	R	100 ... 300 %
	D	100 %
	F	Bridge A current limit may be increased by this value per cent, provided that you program P060 > 100%. Such value is applied to the present current limit resulting from the composition of the values set in all relevant parameters (see parameter C000 and parameter set P050 ... P062 - in case of internal current).

WARNING If actual overlimit exceeds the value stated in the OVERLOAD CAPABILITY TABLE, i.e. 150% of the drive rated current for 1m every 10m for Size 1 ... 2A and lower values for MODULAR.S, then drive overheating alarm (A022) will trip.

7.2.37 P061: BRIDGE B CURRENT OVERLIMIT

P061 OverLimB	P	P061 - OverLimB (used in DCREG4 only)
*** %	R	100 ... 300 %
	D	100 %
	F	Bridge B current limit may be increased by this value per cent, provided that you program P061 > 100%. This function is to be found in DCREG4 only. Such value is applied to the present current limit resulting from the composition of the values set in all relevant parameters (see parameter C000 and parameter set P050 ... P062 - in case of internal limit).

WARNING

If actual overlimit exceeds the value stated in the OVERLOAD CAPABILITY TABLE, i.e. 150% of the drive rated current for 1m every 10m for Size 1 … 2A and lower values for MODULAR.S, then drive overheating alarm (A022) will trip.

7.2.38 P062: OVERLIMIT DIGITAL OUTPUT DELAY

P062 TFullOvLim	P	P062 - TFullOvLim
**** sec	R	.200 ... 60.0 s
	D	2.00 s
	F	When this time, expressed in seconds, is over, if the drive is still in current overlimit, the *6:FullOverLimit* function is enabled, which is programmed in one of the configurable digital outputs. Said output is disabled as soon as the drive is no longer in overlimit mode.

7.2.39 P070(076): SPEED LOOP PROPORTIONAL GAIN (SECOND GAIN)

P070 KpSpeed ****	P	P070 - KpSpeed P076 - KpSpeed2
	R	.100 ... 100.
P076 KpSpeed2 ****	D	4.00
	F	P070: Speed loop proportional gain. P076: Speed loop second proportional gain. These parameters represent the K_p speed loop proportional gain with the following transfer function: $G(s) = K_p\left(1+\frac{1}{sT_i}\right)$ used for regulation and computed by the speed autotuning. This gain is represented by par. P070 if the digital input configured by setting one of par. C130 … C135 to *8:Second ParmSet* is open, or it is represented by par. P076 if this digital input is closed.

7.2.40 P071(077): SPEED LOOP INTEGRAL TIME (SECOND TIME)

P071 TiSpeed **** sec	P	P071 - TiSpeed P077 - TiSpeed2
	R	.010 ... 5.00 s
P077 TiSpeed2 **** sec	D	1.00 s
	F	P071: Speed loop integral time. P077: Speed loop second integral time. These parameters represent, in seconds, integral time *Ti* of the speed loop having the following transfer function: $G(s) = K_p\left(1+\frac{1}{sT_i}\right)$ used for regulation and computed by the speed autotuning. This time is represented by par. P071 if the digital input configured by setting one of par. C130 ... C135 to *8:Second ParmSet* is open, or it is represented by par. P077 if this digital input is closed.

7.2.41 P073(079): SPEED LOOP ADAPTED PROPORTIONAL GAIN (SECOND GAIN)

P073 KpSpdAdapt ****	P	P073 - KpSpeedAdapt P079 - KpSpeedAdapt2
	R	.100 ... 100.
P079 KpSpdAdapt2 ****	D	4.00 s
	F	P073: Speed loop adapted proportional gain. P079: Speed loop adapted second proportional gain. If the parameter Automatic Adaptation is enabled (par. P082 set at *1:YES*) and *Verr* (M002 up to SW Vers. D3.7) > *Verr2* (P084), these parameters represent the proportional gain used for regulation. The value used is the one set in par. P073 if the digital input configured by setting one of par. C130 ... C135 to *8:Second ParmSet* is open, or it is represented by par. P079 if this digital input is closed. See also the SPEED PARAMETER AUTOADAPTATION chapter.

7.2.42 P074(080): SPEED LOOP ADAPTED INTEGRAL TIME (SECOND TIME)

P074 TiSpdAdapt **** sec	P	P074 - TiSpeedAdapt P080 - TiSpeedAdapt2
	R	.010 ... 5.00 s
P080 TiSpdAdapt2 **** sec	D	1.00 s
	F	P074: Sped loop adapted integral time. P080: Speed loop adapted second integral time. If the parameter Automatic Adaptation is enabled (par. P082 set at *1:YES*) and *Verr* (M002 up to SW Vers. D3.7) > *Verr2* (P084), these parameters represent the integral time used for regulation. The value used is the one set in par. P074 if the digital input configured by setting one of par. C130 ... C135 to *8:Second ParmSet* is open, or it is represented by par. P080 if this digital input is closed. See also the SPEED PARAMETER AUTOADAPTATION chapter.

7.2.43 P082: SPEED PARAMETER AUTO ADAPTATION

P082 AdaptCtrl		
***	P	P082 - AdaptCtrl
	R	0 ... 1
	D	0
	F	This parameter enables the speed parameter auto adaptation following the error variation according to what has been mentioned in parameters P083 and P084 to avoid possible speed overshoots which could occur in case of quick reference variations at constant load (current limit drive), or temporary speed losses in case of quick load variations at constant reference. **0:No.** The auto adaptation is not enabled. **1:Yes.** The auto adaptation is enabled.

NOTE

In both cases a **different programmation** is needed: in the first event, parameters are to be set not only for a proportional gain increase, but also for an integral time increase. In the second case, it is necessary to set an integral time decreasing besides the proportional gain increase. See also SPEED PARAMETER AUTOADAPTATION chapter.

7.2.44 P083: FIRST SPEED ERROR FOR AUTO ADAPTATION

P083 Verr1		
**** %	P	P083 - Verr1
	R	0.00 ... 100 %
	D	.500 %
	F	This is the speed error value, expressed as a percentage of the max. error corresponding to 10V, below which the speed PI will use parameters P070 and P071 or P076 and P077, should the digital input configured by setting one parameter among C130 ... C135 to *8:Second ParmSet* be respectively open or closed.

WARNING

In this parameter, do not save any value exceeding the one saved in EEPROM for P084, as this will cause the drive malfunction. See also SPEED PARAMETER AUTOADAPTATION chapter.

7.2.45 P084: SECOND SPEED ERROR FOR AUTO ADAPTATION

P084 Verr2		
**** %	P	P084 - Verr2
	R	0.00 ... 100 %
	D	1.00 %
	F	This is the speed error value, expressed as a percentage of the max. error corresponding to 10V, above which the speed PI (as long as the Parameter Autoadaptation is enabled - parameter P082 set to *1:YES*) will use parameters P073 and P074 or P079 and P080, should the digital input configured by setting one parameter among C130 ... C135 to *8:Second ParmSet* be respectively open or closed.

WARNING

In this parameter, do not save any value lower than the one saved in EEPROM For P083, as this will cause the drive malfunction.
See also SPEED PARAMETER AUTOADAPTATION chapter.

7.2.46 P085: SPEED INTEGRAL TIME INCREMENT DURING RAMP

P085 TiRampScale		
x ****	P	P085 - TiRampScale
	R	x1 ... x1000
	D	x1
	F	Multiplication factor of the speed PI integral time during the ramp transient set inside the drive.

7.2.47 P086: ARMATURE COMPENSATION

P086 ArmatureCmp		
*** %	P	P086 - ArmatureCmp
	R	0 ... 100 %
	D	100%
	F	Value of the compensation of RxI resistive drop in the motor so as to adjust the speed (back-electromotive force) using Varm as a feedback. It expresses, as a percentage of the value set in par. P088 *(RxI)*, the quantity used in the armature resistive drop compensation. 100% of this parameter corresponds to par. P088 whole value used for compensation.

7.2.48 P087: OFFSET OVER THE SPEED ERROR

P087 VerrOffset		
****** %	P	P087 - VerrOffset
	R	-1.000 ... 1.000 %
	D	0.000 %
	F	This parameter, using the value per cent of the max. reference corresponding to 10V, allows the offset fine-tuning at the output of the speed loop, i.e. of the speed error. You may adjust this parameter whenever the motor tends to turn slowly even if the speed / voltage reference is equal to zero. The value set in this parameter is neither subject to the polarity limits relating to parameter P012 nor to any min. and/or max. value imposed by parameters P013 ... P016.

7.2.49 P088: ARMATURE RESISTIVE DROP

P088 RxI		
***	P	P088 – RxI
	R	0 ... 100 V
	D	0 V
	F	This parameter, expressed in Volts, indicates the motor armature resistive drop with a current equal to the drive nominal current, which is computed by the autotuning function - set par. P001 at *3:RxI*. This parameter value is generally used to compute the back-electromotive force and to display it in par. M007 *(BEMF)*. This value is also used for the armature resistive drop compensation both for the dynamic regulation of the field current in field weakening mode and in the armature feedback (as a percentage set in par. P086).

WARNING A software lock exists avoiding increasing par. P088 value until the value set in par. P011 (*VarmMax*) is exceeded.

WARNING **In this parameter, do not save any value exceeding** the one saved in EEPROM for P011, as this will cause the drive malfunction.

7.2.50 P100: CURRENT LOOP PROPORTIONAL GAIN

P100 KpCurr		
****	P	P100 - KpCurr
	R	.005 ... 1.50 (**from SW Vers. D3.09**; .005 ... 1.00 **up to SW Vers. D3.07**)
	D	.200
	F	If the current loop operation has been programmed by setting parameter C051 to *0:PI operating*, this parameter will indicate proportional gain K_p of the current loop, with the following transfer function: $G(s) = K_p + \frac{1}{sT_i}$ used for the control.

7.2.51 P101: CURRENT LOOP INTEGRAL TIME WITH DISCONTINUOUS CURRENT CONDUCTION

P101 TiCurrDisc		
**** ms	P	P101 - TiCurrDisc
	R	1.00 ... 100. ms
	D	1.30 ms
	F	If the current loop operation has been programmed by setting parameter C051 to *0:PI operating*, this parameter will indicate integral time T_i (expressed in milliseconds)of the current loop, with the following transfer function: $G(s) = K_p + \frac{1}{sT_i}$ used for the control in case of discontinuous current conduction, i.e. whenever the output current is left at zero for given time intervals. A decrease in the value set in this parameter determines a faster switch off of the active bridge during reversal.

7.2.52 P102: CURRENT LOOP INTEGRAL TIME WITH CONTINUOUS CURRENT CONDUCTION

P102 TiCurrCont		
**** ms	P	P102 - TiCurrCont
	R	2.00 ... 320 ms
	D	32.0 ms
	F	If the current loop operation has been programmed by setting parameter C051 to *0:PI operating*, this parameter will indicate integral time T_i - expressed in milliseconds - of the current loop, with the following transfer function: $G(s) = K_p + \frac{1}{sT_i}$ used for the control in case of discontinuous current conduction, i.e. whenever the output current is left at zero for given time intervals. A decrease in the value set in this parameter determines a faster dynamic response to a reference step.

7.2.53 P103: ARMATURE EQUIVALENT RESISTIVE DROP

P103 Rxl Pred		
***** V	P	P103 - Rxl Pred
	R	0.000 ... 283.6 V
	D	70.92 V
	F	If the current loop operation has been programmed by setting parameter C051 to *1:Predictive=>J1*, this parameter will indicate, in Volts, the value of the motor armature equivalent resistive drop, with a current value equal to the drive rated value. The equivalent armature resistive drop takes account of the electric ratings of the motor as well as the control chain.

7.2.54 P104: ARMATURE EQUIVALENT INDUCTIVE DROP

P104 LdI/dt Pred		
***** V	P	P104 - LdI/dt Pred
	R	0.000 ... 2.828 V
	D	0.707 V
	F	If the current loop operation has been programmed by setting parameter C051 to *1:Predictive=>J1*, this parameter will indicate, in Volts, the value of the motor armature equivalent inductive drop, with a current variation - in a millisecond - from zero to the drive rated value, that is calculated by the current autotuning.

7.2.55 P110: FIELD REGULATOR VOLTAGE LOOP PROPORTIONAL GAIN

P110 KpFld		
****	P	P110 - KpFld
	R	.050 ... 100.
	D	2.00
	F	Proportional gain K_p of the field regulator voltage loop, with the following transfer function: $G(s) = K_p\left(1+\frac{1}{sT_i}\right)$ used for regulation.

7.2.56 P111: FIELD REGULATOR VOLTAGE LOOP INTEGRAL TIME

P111 TiFld		
**** sec	P	P111 - TiFld
	R	.100 ... 1.00 s
	D	.100 s
	F	This parameter indicates, in seconds, integral time T_i of the field regulator voltage loop, with the following transfer function: $G(s) = K_p\left(1+\frac{1}{sT_i}\right)$ used for regulation.

7.2.57 P120: Speed / Voltage Main Input Polarity

P120 VrefPol		
***	P	P120 - VrefPol
	R	0 ... 2
	D	0
	F	This parameter sets the polarity allowed for *REF* main reference between terminals 5 and 7 AFTER applying *Gain* and *Bias* operators. This is true only if this input is a speed / voltage reference, i.e. when the digital input programmed for the *6:Slave* function is open (see par. C130 ... C135). **0:Bipolar.** Bipolar reference. **1:Positive only.** Positive reference only. **2:Negative only.** Negative reference only. If you program a unipolar *REF* reference, the reference of the opposite polarity will be shut and considered as equal to zero.

7.2.58 P121: Speed / Voltage Main Input Bias

P121 VrefBias		
******%	P	P121 - VrefBias
	R	-400.0 ... 400. %
	D	0.000 %
	F	This parameter represents, as a percentage of the max. value corresponding to 10V, the reference value obtained when the signal applied to the *REF* main input between terminals 5 and 7 is equal to zero. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P122}{100} + 10 \cdot \frac{P121}{100}$ This is true if this signal is a speed / voltage reference, i.e. when the digital input programmed for the *6:Slave* function is open (see par. C130 ... C135).

7.2.59 P122: Speed / Voltage Main Input Gain

P122 VrefGain		
******%	P	P122 - VrefGain
	R	-800.0 ... 800.0 %
	D	100.0 %
	F	This parameter represents the amplification which is internally applied to the *REF* main reference signal between terminals 5 and 7, before being summed to the *Bias*. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P122}{100} + 10 \cdot \frac{P121}{100}$ This is true if this signal is a speed / voltage reference, i.e. when the digital input programmed for the *6:Slave* function is open (see par. C130 ... C135).

7.2.60 P123: Main Current Input Polarity

P123 IrefPol	P	P123 - IrefPol
***	R	0 ... 2
	D	0
	F	This parameter sets the allowable polarity for the *REF* main input between terminals 5 and 7 AFTER applying the *Gain* and *Bias* operators. This is true if this input is a current reference, i.e. when the digital input programmed for the *6:Slave* function (see par. C130 ... C135) is closed. **0:Bipolar.** Bipolar reference. **1:Positive only.** Positive reference only. **2:Negative only.** Negative reference only. If you program a unipolar *REF* reference, the reference with the opposite polarity will be shut and considered as equal to zero.

7.2.61 P124: Current Main Input Bias

P124 IrefBias	P	P124 - IrefBias
******%	R	-400.0 ... 400.0 %
	D	0.000 %
	F	This parameter represents, as a percentage of the max. reference corresponding to 10V, the reference value obtained when the signal applied to the *REF* main input between terminals 5 and 7 is equal to zero. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P125}{100} + 10 \cdot \frac{P124}{100}$ This is true if this signal is a current reference, i.e. when the digital input programmed for the *6:Slave* function is closed (see par. C130 ...C135).

7.2.62 P125: Current Main Input Gain

P125 IrefGain	P	P125 - IrefGain
******%	R	-800.0 ... 800.0 %
	D	100.0 %
	F	This parameter represents the amplification which is internally applied to the *REF* main reference between terminals 5 and 7, before being summed to the *Bias*. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P125}{100} + 10 \cdot \frac{P124}{100}$ This is true if this signal is a current reference, i.e. when the digital input programmed for the *6:Slave* function is closed (see par. C130 ...C135).

NOTE

With two drives in MASTER / SLAVE configuration, as the reference standard level supplied by the MASTER drive is 5V at the nominal current (M003 = 100%), if also the SLAVE drive must supply its nominal current - with said reference at *REF* main reference between terminals 5 and 7 - gain P125 *(IrefGain)* is to be set at 200%.

7.2.63 P126(129)(132): POLARITY FOR AUXILIARY ANALOG INPUT 1(2)(3

P… AnInxPol	P	P126(129)(132) – AnIn1(2)(3)Pol
***	R	0 ... 2
	D	0
	F	P126: Polarity for auxiliary analog input 1 (*IN 1*) to terminals 11 and 13. P129: Polarity for auxiliary analog input 2 (*IN 2*) on terminal 17. P132: Polarity for auxiliary analog input 3 (*IN 3*) on terminal 19. This parameter sets the allowable polarity for auxiliary reference 1(2)(3) (*IN x*) AFTERapplying the *Gain* and *Bias* operators. **0:Bipolar.** Bipolar reference. **1:Positive only.** Positive reference only. **2:Negative only.** Negative reference only. If a unipolar auxiliary reference is programmed, the reference of the opposite polarity - if any - will be shut and considered as equal to zero.

7.2.64 P127(130)(133): AUXILIARY ANALOG INPUT 1(2)(3) BIAS

P… AnInxBias	P	P127(130)(133) - AnIn1(2)(3)Bias
****** %	R	-400.0 ... 400.0 %
	D	0.000 %
	F	P127: Bias for auxiliary analog input 1 to terminals 11 and 13. P130: Bias for auxiliary analog input 2 on terminal 17. P133: Bias for auxiliary analog input 3 on terminal 19. This parameter indicates, as a percentage of the max. reference corresponding to 10V, the reference value obtained when the signal applied to the terminal board is equal to zero. Signal V2 obtained when applying the *Gain* and *Bias* operators to signal V1 is given by the following formula: $V_2 = V_1 \cdot \frac{P...[Gain]}{100} + 10 \cdot \frac{P...[Bias]}{100}$

7.2.65 P128(131)(134): AUXILIARY ANALOG INPUT 1(2)(3) GAIN

P… AnInxGain	P	P128(131)(134) - AnIn1(2)(3)Gain
****** %	R	-800.0 ... 800.0 %
	D	100.0 %
	F	P128: Gain for analog input 1 to terminals 11 and 13. P131: Gain for analog input 2 on terminal 17. P134: Gain for analog input 3 on terminal 19. This parameter indicates the amplification which is internally applied to the signal in the terminal board before summing the *Bias*. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P...[Gain]}{100} + 10 \cdot \frac{P...[Bias]}{100}$

7.2.66 P150(153): ANALOG OUTPUT 1(2) CONFIGURATION

P... AnOutxCfg		P150(153) - AnOut1(2)Cfg
***	R	0 ... 13
	D	0
	F	P150: It indicates the configuration of analog output 1 *(OUT 1)* to terminal 8. P153: It indicates the configuration of analog output 2 *(OUT 2)* to terminal 10. **0:0 Volt.** 0 Volt. **1:Ramped Vref.** Ramp block output: 10V at 100% of the max. reference. **2:Speed Error.** Speed error: 10V with *Verr* (M002 up to SW Vers. D3.7) = 100%. **3:SpeedLoop OUT.** Speed loop output, i.e. input signal of current limitation lock: 10V with the *n setpoint* global speed / voltage reference at 128% of the max. value, the feedback (M001) at 0% and the proportional gain (P070, P076, P073 or P079 depending on the circumstances) equal to 1 (supposing that only the proportional part of PI regulator is active). **4:Current Ref.** Current reference: 5V with M003 = 100%. For a drive pair having a MASTER / SLAVE configuration, the current reference to be given by the master drive may be obtained on terminal 8(10) if P150(153) = *4:Current ref*. **5:BackEMF.** Back-electromotive force: 5V with M007 =511V. **6:Output Power.** Power resulting from the product of the output voltage by the output current: 10V with M006 = 800V and M004 = 150% of the drive rated current. E.g. if M006 = 400V and with the drive rated current (e.g. 100A for a DCREG.100), the analog output value will be 3.33V. **7:Inertia Comp.** Three-value signal for the external synchronization of the inertia compensation during tension tests. Throughout the acceleration ramp: -10V, with rated speed: 0V, throughout the deceleration ramp: +10V. **8:nFdbk.** Speed feedback signal (voltage): 10V with M001 = 100% **9:ArmatureCurr.** Armature current feedback signal. The value is 6.67V according to the rated current of the drive (e.g. 100A for a DCREG.100). **10:FieldCurrent.** Field current feedback signal. The value is 10V according to the drive rated current, whose standard values are 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2(A) and MODULAR.S. **11:Motor Torque.** Signal of the motor torque resulting from the product of the armature current by the field current. Its value is 6.67V with the motor armature nominal current (defined by par. C000) and by the motor field nominal current (defined by par. C010). **12:FieldBus1**. Analog signal 1 reiterated at output, resulting from the conversion of an analog quantity sent by the field bus at input. **13:FieldBus2**. Analog signal 2 reiterated at output, resulting from the conversion of an analog quantity sent by the field bus at input.

NOTE

The above-mentioned Volt values which can be obtained by the two analog outputs relate to jumpers JP9 and JP10 of board ES801 (JP409 and JP4010 in ES906) in pos. 1-2. Should they be placed in pos. 2-3, the two analog outputs will deliver only an **outgoing** current signal equal to 0 ... 20mA from the terminal: in this case, the value to be set on the parameters relating to *Gain* and *Bias* operators is shown in the MILLIAMPERE INPUT / OUTPUT SIGNALS chapter.

7.2.67 P151(154): ANALOG OUTPUT 1(2) BIAS

P... AnOutxBias		
****** %	P	P151(154) - AnOut1(2)Bias
	R	-400.0 ... 400.0 %
	D	0.000 %
	F	P151: Bias for analog output 1 on terminal 8. P154: Bias for analog output 2 on terminal 10. This parameter indicates, as a percentage of the max. signal corresponding to 10V, the value of the signal generated in the terminal board when the internal signal is equal to zero. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P...[Gain]}{100} + 10 \cdot \frac{P...[Bias]}{100}$

7.2.68 P152(155): ANALOG OUTPUT 1(2) GAIN

P... AnOutxGain		
****** %	P	P152(155) - AnOut1(2)Gain
	R	-800.0 ... 800.0%
	D	100.0 %
	F	P152: Gain for analog output 1 on terminal 8 P155: Gain for analog output 2 on terminal 10 This parameter indicates the amplification that is internally applied to the generated signal before summing the *Bias*. Signal V_2 obtained when applying the *Gain* and *Bias* operators to signal V_1 is given by the following formula: $V_2 = V_1 \cdot \frac{P...[Gain]}{100} + 10 \cdot \frac{P...[Bias]}{100}$

7.2.69 P156: ANALOG IOUT POLARITY ON TERMINAL 6

P... AnOutxGain		
***	P	P156 - IOutPol (used in DCREG4 only)
	R	0 ... 1
	D	DCREG4: 0 DCREG2: 1(not used)
	F	This parameter defines the range of current analog output *I Out* on terminal 6. It is available in DCREG4 only. **0:Bipolar.** Bipolar range: the ammeter connected is to be a central-zero one. **1:Positive only.** Unipolar range: the ammeter connected is NOT to be a central-zero one.

7.2.70 P157(158): ANALOG OUTPUT POLARITY 1(2)

P… AnOutxPol		
***	P	P157(158) - AnOut1(2)Pol
	R	0 ... 1
	D	0
	F	P157: Polarity with which the signal in Volt can be generated by analog output 1 on terminal 8 P158: Polarity with which the signal in Volt can be generated by analog output 2 on terminal 10 **0:Bipolar.** Bipolar range. **1:Positive only.** Unipolar range, only positive in the two above mentioned outputs.

NOTE

This parameter is active only if the signal set on the analog output is a voltage signal (-10 ... 10V) (jumper JP9 and/or JP10 in pos. 1-2). If a current signal (0 ... 20mA) (jumper JP9 and/or JP10 in pos. 2-3) is to be brought to the output at issue, polarity may not be defined, as the current direction is the one outgoing from the terminal towards zero volt

7.2.71 P170(176)(182)(188)(194): DIGITAL OUTPUT 1(2)(3)(4)(5) CONFIGURATION

P... MDOxCfg	P	P170(176)(182)(188)(194) - MDO1(2)(3)(4)(5)Cfg
***	R	0 ... 13 (**from SW Vers. D3.09**; 0 ... 11 **up to SW Vers. D3.07**)
	D	P170: 0 P176: 1 P182: 2 P188: 5 P194: 4
	F	P170: It indicates the configuration of digital output 1 *(MDO 1)* to terminals 25 and 27. P176: It indicates the configuration of digital output 2 *(MDO 2)* to terminals 29 and 31. P182: It indicates the configuration of digital output 3 *(MDO 3)* to terminals 33 and 35. P188: It indicates the configuration of digital output 4 *(MDO 4)* to terminals 37 and 39. P194: It indicates the configuration of digital output 5 *(MDO 5)* to terminals 41 and 43. **0:Drive OK.** No alarm is active. **1:SpeedThreshold.** The speed / voltage threshold set has been overcome. **2:Iarm Threshold.** The armature current threshold set has been overcome. **3:Motor at Speed.** The speed / voltage set at the ramp circuit input has been reached - i.e. the ramp transient has been performed. This function is enabled as long as the drive is running. **4:CurrLimitation.** The drive is in a current limit state, i.e. the armature current is at the max. value allowed at that moment. **5:Drive Running.** The drive is running (it is controlling). **6:Full OverLimit.** The drive has been in a current overlimit state throughout the time set in P062. **7: Fld Weakening.** The dynamic regulation of the field current in field weakening mode is in progress. **8: Ifld Threshold.** The field current threshold set has been overcome. **9:Vref Threshold.** The reference threshold has been overcome. **10:No warnings.** No warning is displayed on the *Status* page. **11:FieldBus.** Relay contact reiterated at output, resulting from the conversion of a digital signal sent by the field bus at input. **From SW Vers. D3.09 only:** **12:OUT Timer A**. Same output signal as the signal sent to one of configurable digital inputs *MDIx* if one of them is set as *19:IN TimerA*. This signal is reproduced based on timing set for *MDO1(2)(3)(4)(5)OnDelay* and *MDO1(2)(3)(4)(5)OffDly* and based on logics set for *MDO1(2)(3)(4)(5)Logic*. **13:OUT Timer B**. Same output signal as the signal sent to one of configurable digital inputs *MDIx* if one of them is set as *20:IN TimerB*. This signal is reproduced based on timing set for *MDO1(2)(3)(4)(5)OnDelay* and *MDO1(2)(3)(4)(5)OffDly* and based on logics set for *MDO1(2)(3)(4)(5)Logic*.

WARNING The indication provided by the digital input configured as *3:Motor at Speed* **does not** consider any additional speed reference.

7.2.72 P171(177)(183)(189)(195): DIGITAL OUTPUT 1(2)(3)(4)(5) ON DELAY

P... MDOxOnDelay	P	P171 (177)(183)(189)(195) - MDO1(2)(3)(4)(5)OnDelay
***** sec	R	0.000 ... 600.0 s
	D	0.000 s
	F	P171: Delay time, expressed in seconds, enabling digital output 1 to terminals 25 and 27. P177: Delay time, expressed in seconds, enabling digital output 2 to terminals 29 and 31. P183: Delay time, expressed in seconds, enabling digital output 3 to terminals 33 and 35. P189: Delay time, expressed in seconds, enabling digital output 4 to terminals 37 and 39. P195: Delay time, expressed in seconds, enabling digital output 5 to terminals 41 and 43. This parameter indicates, in seconds, the delay time that actually enables the digital output starting from the time when all necessary requirements are met. See also figure in the CONFIGURABLE DIGITAL OUTPUTS chapter.

7.2.73 P172(178)(184)(190)(196): DIGITAL OUTPUT 1(2)(3)(4)(5) OFF DELAY

P... MDOxOffDly	P	P172(178)(184)(190)(196) - MDO1(2)(3)(4)(5)OffDly
***** sec	R	0.000 ... 600.0 s
	D	0.000 s
	F	P172: Delay time, expressed in seconds, disabling digital output 1 to terminals 25 and 27. P178: Delay time, expressed in seconds, disabling digital output 2 to terminals 29 and 31. P184: Delay time, expressed in seconds, disabling digital output 3 to terminals 33 and 35. P190: Delay time, expressed in seconds, disabling digital output 4 to terminals 37 and 39. P196: Delay time, expressed in seconds, disabling digital output 5 to terminals 41 and 43. This parameter indicates, in seconds, the delay time that actually disables the digital output starting from the time when all necessary requirements are met. See also figure in the CONFIGURABLE DIGITAL OUTPUTS chapter.

7.2.74 P173(179)(185)(191)(197): DIGITAL OUTPUT 1(2)(3)(4)(5) SWITCHING LEVEL

P... MDOxLevel	P	P173(179)(185)(191)(197) - MDO1(2)(3)(4)(5)Level
*** %	R	0 ... 200 %
	D	P173: 50% P179: 3 % P185: 50% P191: 5 % P197: 50%
	F	P173: Speed / voltage level, current level, error level or reference level for the switching of digital output 1 to terminals 25 and 27 (if it is set according to one of said indications). P179: Speed / voltage level, current level, error level or reference level for the switching of digital output 2 to terminals 29 and 31(if it is set according to one of said indications). P185: Speed / voltage level, current level, error level or reference level for the switching of digital output 3 to terminals 33 and 35 (if it is set according to one of said indications). P191: Speed / voltage level, current level, error level or reference level for the switching of digital output 4 to terminals 37 and 39 (if it is set according to one of said indications). P197: Speed / voltage level, current level, error level or reference level for the switching of digital output 5 to terminals 41 and 43 (if it is set according to one of said indications).

NOTE

The digital output configured as *1:SpeedThreshold* enables when the speed absolute value in M001 *(nFdbk)* is higher than this parameter value. The digital output configured as *2:Iarm Threshold* enables when the current absolute value in M004 (*Iarm*) - expressed as a percentage of the drive armature nominal current, is higher than this parameter value. The digital output configured as *8:Ifld Threshold* enables when the current in M018 (*Ifld*) - expressed as a percentage of the drive field nominal current - is higher than this parameter value. Similarly, the digital output configured as *9:VrefThreshold* enables when the speed error absolute value between the *Vref* reference displayed on the *KeyPad* becomes higher than this parameter's value. Finally, the digital input configured as *3:Motor at Speed* enables when the speed error absolute value between the ramp circuit input reference and the speed / voltage feedback is lower than this parameter value. This means that the actual speed has reached the programmed setpoint; i.e. the ramp transient is over.

NOTE

The level value set in these parameters cannot be lower than the value set in *MDOxHyst*-type parameters.

WARNING

To avoid any drive malfunction, **never save a value lower** than the one saved in EEPROM for *MDOxHyst*-type parameters.

7.2.75 P174(180)(186)(192)(198): DIGITAL OUTPUT 1(2)(3)(4)(5) SWITCHING HYSTERESIS

P... MDOxHyst		
** %	P	P174(180)(186)(192)(198) - MDO1(2)(3)(4)(5)Hyst
	R	0 ... 200 %
	D	2 %
	F	P174: Hysteresis level for the enabling/disabling of digital output 1 to term. 25 and 27. P180: Hysteresis level for the enabling / disabling of digital output 2 to term. 29 and 31. P186: Hysteresis level for the enabling / disabling of digital output 3 to term. 33 and 35. P192: Hysteresis level for the enabling / disabling of digital output 4 to term. 37 and 39. P198: Hysteresis level for the enabling / disabling of digital output 5 to term. 41 and 43.

NOTE This parameter defines the switching hysteresis of the digital output considered below the value fixed by *MDOxLevel*. See also figure in the CONFIGURABLE DIGITAL OPUTPUTS.

NOTE The hysteresis value set in these parameters may not exceed the level value set in *MDOxLevel*-type parameters.

WARNING To avoid any drive malfunction, **never save a value higher** than the one saved in EEPROM for *MDOxLevel*-type parameters.

7.2.76 P175(181)(187)(193)(199): DIGITAL OUTPUT 1(2)(3)(4)(5) CONTACT LOGIC

P... MDOxLogic		
***	P	P175(181)(187)(193)(199) - MDO1(2)(3)(4)(5)Logic
	R	0 ... 1
	D	0
	F	P175: It indicates the contact state when digital output 1 to term. 25 and 27 is disabled. P181: It indicates the contact state when digital output 2 to term. 29 and 31 is disabled. P187: It indicates the contact state when digital output 3 to term. 33 and 35 is disabled. P193: It indicates the contact state when digital output 4 to term. 37 and 39 is disabled. P199: It indicates the contact state when digital output 5 to term. 41 and 43 is disabled. **0:Normally Open.** When the output enables, the relevant relay energizes and the contact on the relevant terminals closes. **1:Normally Closed.** When the output enables, the relevant relay de-energizes and the contact on the related terminals opens. See also figure in the CONFIGURABLE DIGITAL OUTPUTS chapter.

7.2.77 P211(212)(213)(214)(215)(216)(217): PRESET RUN REFERENCE 1(2)(3)(4)(5)(6)(7

P... PresetSpdx	P	P211 (212)(213)(214)(215)(216)(217): Preset Run Reference 1(2)(3)(4)(5)(6)(7)
***** %	P	P211 (212)(213)(214)(215)(216)(217) - PresetSpd1(2)(3)(4)(5)(6)(7)
	R	-100. ... 100. %
	D	P211: 5.00 % P212: 20.0 % P213: 10.0 % P214: 0.00 % P215: -5.00 % P216: -20.0 % P217: -10.0 %
	F	P211: Preset run reference *PresetSpd1*. P212: Preset run reference *PresetSpd2*. P213: Preset run reference *PresetSpd3*. P214: Preset run reference *PresetSpd4*. P215: Preset run reference *PresetSpd5*. P216: Preset run reference *PresetSpd6*. P217: Preset run reference *PresetSpd7*. These references are speed / voltage references to be used instead of the *Main Ref* reference. Their polarity may be reversed using the *Reverse* function. If a digital input programmed for the *6:Slave* function (see par. C130 ... C135) is closed, or if par. C050 has been directly programmed for the *3:Iref=Vref* function, then the above-mentioned preset run references become current references. When a run preset reference is entered, the START digital input is to be enabled.

SELECTION: Among the seven preset run references to be stored, the valid one results from the closing of one or more digital inputs that have been properly configured.
If three digital inputs are set to *1:Preset Speed A, 2:Preset Speed B* and *3:Preset Speed C*, the preset run reference is determined by the table below, where a blank square indicates the digital input opening state (or the input that has **not been set**) and the black square indicates the closing state:

Selected run reference	PresetSpdC	PresetSpdB	PresetSpdA
Main Ref	☐	☐	☐
PresetSpd1	☐	☐	■
PresetSpd2	☐	■	☐
PresetSpd3	☐	■	■
PresetSpd4	■	☐	☐
PresetSpd5	■	☐	■
PresetSpd6	■	■	☐
PresetSpd7	■	■	■

Among the seven preset run references, if you want to select only the first three ones, you just need to set two digital inputs as *1:Preset Speed A* and *2:Preset Speed B*. For one reference only, you just need to set one input to *1:Preset Speed A* (first input), *2:Preset Speed B* (second input), *3:Preset Speed C* (fourth input).

7.2.78 P221: JOG RAMP SELECTION

P221 JogSelect	P	P221 - JogSelect
***	R	0 ... 2
	D	0
	F	This parameter defines the ramps to be assigned to the jog references. **0:Common Ramps.** The jog references pass through common ramps P030, P031, P032, P033. When the jog digital input opens, ramp P034 or P035 takes place, depending on the polarity programmed. **1:Without Ramps.** The jog references are directly taken. **2:Separate Ramps.** The jog references pass through separate ramps P036, P037. Ramp P037 takes place both when the value set in this parameter decreases and when the jog digital input opens.

7.2.79 JOG REFERENCE 1(2)(3)

P... Jogx	P	P222(223)(224) - Jog1(2)(3)
***** %	R	-100. ... 100. %
	D	P222: 5.00 % P223: -5.00 % P224: 0.00 %
	F	P222: *Jog1* Reference. P223: *Jog2* Reference. P224: *Jog3* Reference. These references are speed / voltage references whose polarity may be reversed by applying the *Reverse* function. If a digital input programmed for the *6:Slave* function (see par. C130 ... C135) is closed, or if par. C050 has been directly programmed for the *3:Iref=Vref*, then the above-mentioned jog references become current references.

SELECTION: Among the three jog references to be stored, the valid one results from the closing of one or more digital inputs that have been properly configured.
If two digital inputs are set to *12:JogA* and *13:JogB*, the preset jog reference is determined by the table below, where a blank square indicates the digital input opening state (or the input that has **not been set**) and the black square indicates the closing state:

Selected jog reference	JogB	JogA
-	☐	☐
Jog1	☐	■
Jog2	■	☐
Jog3	■	■

If you want to select only one jog reference out of three, you just need to set one input with values *12:JogA* for the first and *13:JogB* for the second.

7.2.80 P230: MIN. FIRING ANGLE

P230 AlfaMin		
**** °	P	P230 - AlfaMin
	R	0.00 ... 80.0°
	D	DCREG4: 30.0° DCREG2: 25.0°
	F	Min. delay angle for the thyristor firing and the energy transfer from the mains to the load. This is the limit for parameter M005 *(Alfa)* when the drive operates as "motor".

7.2.81 P231: MAX. FIRING ANGLE

P231 AlfaMax		
**** °	P	P231 - AlfaMax
	R	100. ... 180.°
	D	150.°
	F	Max. delay angle for the thyristor firing and the energy transfer from the load to the mains. This is the limit for parameter M005 *(Alfa)* when the drive operates as "brake".

7.2.82 P240: LOW PASS FILTER OVER THE SPEED / VOLTAGE ERROR

P240 LowPassCnst		
**** msec	P	P240 - LowPassConst
	R	0.00 ... 300. ms
	D	0.00 ms
	F	This parameter expresses, in milliseconds, time constant τ of the low pass filter for the first speed error operating according to the following transfer function: $G(s) = \frac{1}{1+s\tau}$.

7.2.83 P250: UP / DOWN INTERNAL REFERENCE POLARITY

P250 UpDnRefPol		
***	P	P250 - UpDnRefPol
	R	0 ... 2
	D	0
	F	This parameter sets the allowable polarity for the *UpDownRef* internal reference. See also the MOTOR POTENTIOMETER chapter. **0:Bipolar**. Bipolar reference. **1:Positive only**. Positive reference only. **2:Negative only**. Negative reference only.

7.2.84 P251: UP / DOWN INTERNAL REFERENCE RESTORATION AT POWER ON

P251 UpDnRefMem		
***	P	P251 - UpDnRefMem
	R	0 ... 1
	D	1
	F	If set at default value *1:Yes*, this parameter restores the last value stored for the *UpDownRef* internal reference before or a power failure or the device power off. Otherwise (*0:No* setting) this internal reference will always restart from zero. See also the MOTOR POTENTIOMETER chapter. **0:No**. Reset zero value at power on. **1:Yes**. Restoration at power on.

7.3 CONFIGURATION PARAMETERS

The value of the configuration parameters may be defined by the user **only when** the *ENABLE* digital input is not active. These parameters are marked with a **C** followed by the parameter number.

7.3.1 C000: MOTOR RATED CURRENT

C000 Inom		
*** %	P	C000 - Inom
	R	1 ... 100 %
	D	100 %
	F	This parameter sets the motor rated current as a percentage of the drive rated current. For instance, for a DCREG.100, 100% of C000 corresponds to 100A. This parameter is the reference value for all calculations relating to the different current limits.

7.3.2 C001: CURRENT FOR MOTOR THERMAL PROTECTION

C001 MotThrshold		
*** %	P	C001 - MotThrshold
	R	1 ... 120 %
	D	110 %
	F	This parameter sets - as a percentage of the motor rated current programmed on parameter C000 - the reference current for the thermal image formation of motor temperature increase to enable the motor electronic protection agaist overheating (protection I^2t). See also figure in MOTOR HEATING THERMAL IMAGE chapter. For instance, in a DCREG.100 where a value equal to C000=80% has been set, 110% of C001corresponds to 88A.

7.3.3 C002: TIME CONSTANT FOR MOTOR THERMAL PROTECTION

C002 MotThConst		
***** sec	P	C002 - MotThConst
	R	0 ... 10800 s
	D	300 s
	F	This parameter sets, in seconds, the thermal time constant for thermal image formation of motor temperature increase to enable the motor electronic protection against overheating (protection I^2t). See also figure in MOTOR HEATING THERMAL IMAGE chapter. Program C002=0 to disable I^2t control. As a reference, in parameter C002 you can set a value of approx.600 sec for motors with some hundreds of Ampere, while a value up to 1800 sec may be set for motors with some thousands of Ampere.

7.3.4 C010: MOTOR FIELD RATED CURRENT

C010 IfldNom		
**** %	P	C010 - IfldNom
	R	0.00 ... 100. %
	D	10.0 %
	F	This parameter is to be **always** programmed, even if no dynamic regulation of the field current in field weakening mode is needed. This parameter sets, as a percentage of the max. field current value supplied by the drive, the motor field rated current supplied when the motor is not running or when the motor is rotating at a lower speed than the speed enabling the field regulation. The value set in this parameter may be reduced from its max. value to zero through one of the configurable analog inputs by setting par. C120 (121)(122) to *11:Fld.curr.lim*.

NOTE

The standard values of the max. field current that the drive can deliver are 5A for DCREG.100max, 15A for DCREG.150min Size 1 and 35A for DCREG Size 2(A) and MODULAR.S.
For instance, for a DCREG.350, 100% of C010 corresponds to 15A.

7.3.5 C011: FIELD WEAKENING START RATED SPEED

C011 BaseSpeed		
*** %	P	C011 - BaseSpeed
	R	5 ... 100 %
	D	33 %
	F	This parameter shall be programmed only when a dynamic regulation of the field current in field weakening mode is needed. It sets the speed, expressed as a percentage of P010 (*nFdbkMax*), determining the field weakening start. See also the FIELD REGULATOR chapter.

7.3.6 C012: RATED ARMATURE VOLTAGE AT FIELD WEAKENING

C012 BaseVarm		
**** V	P	C012 - BaseVarm
	R	50 ... 1000 V
	D	1000V
	F	It sets, in Volts, the motor nominal armature voltage, already obtained at the speed determining the field weakening start. To have a field current dynamic regulation in field weakening mode when the speed changes: **1.** set this parameter at a value lower than 1000V **2.** with par. C70, set a feedback speed other than value *4:Armature*. If the speed feedback set is the armature feedback, no field current dynamic regulation in field weakening mode will take place for any value of the actual parameter. See also FIELD REGULATOR chapter.

WARNING

For this parameter, set a lower value than the default value (1000V) only in field weakening dynamic regulation mode. Otherwise, if the field current value is to be kept constant, do not change this parameter's default value.

7.3.7 C014: STANDSTILL FIELD CURRENT

C014 FldEcoLevel		
*** %	P	C014 - FldEcoLevel
	R	0 ... 100 %
	D	10 %
	F	This parameter may be programmed even when no dynamic regulation of the field current in field weakening mode is needed. It represents the current value, expressed as a percentage of C010 (*IfldNom*), to which the field must be reduced when the drive is not running, once the time set at parameter C015 (*FldEcoDelay*) has elapsed. As soon as the device is supplied at the terminals of the field rectifier and as long as the run command is not operated, the field current value supplied is the one set in the current parameter. The *Field Economy* function is disabled whenever the motor speed of rotation is other than zero. See also the FIELD REGULATOR chapter.

7.3.8 C015: STANDSTILL FIELD CURRENT DECREASE DELAY

C015 FldEcoDelay		
*** sec	P	C015 - FldEcoDelay
	R	0.0 ... 300
	D	240 s
	F	This parameter may be programmed even when no dynamic regulation of the field current in field weakening mode is needed. This parameter indicates, in seconds, the time interval that has to pass before reducing the field current to value C014 *(FldEcoLevel)*, starting from the time when the drive stops. See also the FIELD REGULATOR chapter.

7.3.9 C016: FIELD WEAKENING MIN. CURRENT

C016 IfldMinLim		
*** %	P	C016 - IfldMinLim
	R	10 ... 100 %
	D	25 %
	F	This parameter shall be programmed only when a dynamic regulation of the field current in field weakening mode is needed. It sets, as a percentage of C010 *(IfldNom)*, the motor field nominal current min. limit during the dynamic regulation in field weakening mode. Field current can never be lower than the value of actual parameter, even if speed is at its max value. If the motor speed of rotation reaches too high and dangerous values, the correct setting of this parameter allows Alarm A023 *(Ifld Underlimit)* to trip and the equipment to lock. Typically, this parameter could be set at **75%** of the min. current field rated value at the max. speed. See also the FIELD REGULATOR chapter.

7.3.10 C017: Boost over the Field Current

C017 FldFrcLevel		
*** %	P	C017 - FldFrcLevel
	R	100 ... 120 %
	D	100 %
	F	This parameter may be programmed even when no dynamic regulation of the field current in field weakening mode is needed. It represents the value, expressed as a percentage of C010 (*IfldNom*), to which the field current is increased according to the time set at parameter C018 (*FldFrcTime*), starting from the very moment when the run command is operated. This is true only when a digital input configured for the *11:FldFrcEnabled* function is closed.

This forcing function (*Field Forcing*) will be disabled if the armature voltage exceeds the following value $\frac{C030 \cdot 1.316}{2}$, and will be enabled when drive is started again. See also the FIELD REGULATOR chapter.

NOTE Product C010•C017 should **not** exceed the 100% of the field maximum current to be supplied by the device.

NOTE The forcing function may have no effect if the current increase does not produce any remarkable field flux increase.

7.3.11 C018: Boost Duration on Field Current

C018 FldFrcTime		
*** sec	P	C018 - FldFrcTime
	R	0.0 ... 60. s
	D	10. s
	F	This parameter may be programmed even when no dynamic regulation of the field current in field weakening mode is needed. This is the time interval, expressed in seconds, during which the field current is increased according to the percentage set at parameter C017 (*FldFrcLevel*) starting from the very moment when the run command is operated. See also the FIELD REGULATOR chapter.

7.3.12 C030: Nominal Mains Voltage

C030 VmainsNom		
*** V	P	C030 – VmainsNom
	R	10 ... *NNN* V
	D	400 V
	F	This parameter sets, in Volts, the three-phase mains voltage nominal value in the power section. The upper extreme value to be set (i.e. the maximum three-phase voltage to be supplied to the power section) indicated as *NNN*, is factory-set, is shown in the *Status* page and depends on the components used for the device manufacturing. It may be one of the following four values: 440V, 500V, 600V, 690V. The value set in this parameter controls alarm A016 (*Mains OverVoltage*), A017 (*Mains UnderVoltage*) and A010 *(Armature OverVoltage)* trip (mains overvoltage or undervoltage and armature overvoltage respectively).

NOTE The value set in this parameter cannot exceed the drive factory-set value.

7.3.13 C050: SPEED / VOLTAGE LOOP OPERATION

C050 SpdLoopSel		
***	P	C050 - SpdLoopSel
	R	1 ... 3
	D	1
	F	This parameter programs the speed loop operating mode. **1:PI operating.** The PI regulator proportional and integral sections are both active. **2:P operating.** Only the PI regulator proportional section is active. **3:Iref=Vref.** The speed loop is inactive. The current reference is supplied by the *Main Ref* (after being transferred to *Gain, Bias, Polarity* and the *Reverse* function), by one of the internal jog references or by one of the preset run references (with the *Reverse* function, if necessary). The current reference may be summed to *IN 1* reference between terminals 11 and 13, to *IN 2* reference on terminal 17 and to *IN 3* reference on terminal 19 as long as they have been configured by setting C120(121)(122) = *2: I loop add.ref.*, and after being transferred to *Gain, Bias, Polarity*. The current references always enter the control loop with no ramp or rounding, even if they have been set in parameters P030 ... P039.

NOTE

If a digital input configured for the *6:Slave* function is closed, then this parameter programming cannot be changed.

7.3.14 C051: CURRENT LOOP OPERATION

C051 CurrLoopSel		
***	P	C051 - CurrLoopSel
	R	0 ... 1
	D	0
	F	This parameter programs the current loop operating mode. **0:PI operating.** The current loop operates through a PI regulator (proportional part plus integral part). It is recommended that this mode be selected in case of a DCREG4 in armature feedback or in case of a DCREG2 and generally in all cases where the resistance torque is much higher than the inertia one, or when the output bars of the DCREG do not supply a motor but supply a resistive load. **1:Predictive=>J1** (**1:Predictive** up to SW Vers. D3.09). Current loop operates with a predictive control. From SW Vers. D4.00: before setting this operating mode for the current loop and before performing current autotune, set jumper J1 from position 1 to position 0. Jumper J1 is located on board ES729/1 (installed inside the equipment on control board ES728/2).

7.3.15 C052: FIELD REGULATOR VOLTAGE LOOP OPERATION

C052 FldLoopSel		
***	P	C052 - FldLoopSel
	R	0 ... 1
	D	0
	F	This parameter programs the field regulator voltage loop operating mode. **0:PI operating.** Both the PI regulator proportional and integral sections are active. **1:P operating.** Only the PI regulator proportional section is active.

7.3.16 C060: First Quadrant Selection

C060 1stQ-FwdMot		
***	P	C060 – 1stQ-FwdMot
	R	0 … 1
	D	0
	F	Operation enabling/disabling of the first work quadrant of the torque / speed plan. See also figure in the OPERATION QUADRANTS chapter. **0:Enabled**. The first quadrant is enabled. **1:Disabled**. The first quadrant is disabled.

7.3.17 C061: Second Quadrant Selection

C061 2ndQ-RevReg		
***	P	C061 – 2ndQ-RevReg
	R	0 … 1
	D	DCREG4: 0 DCREG2: 0 (DCREG2: 1 **up to SW Vers. D4.00**)
	F	Operation enabling/disabling of the second work quadrant of the torque / speed plan. See also figure in the OPERATION QUADRANTS chapter. **0:Enabled**. The second quadrant is enabled. **1:Disabled**. The second quadrant is disabled.

7.3.18 C062: Third Quadrant Selection

C062 3rdQ-RevMot		
***	P	C062 – 3rdQ-RevMot (used in DCREG4 only
	R	0 … 1
	D	DCREG4: 0 DCREG2: 1 (not used)
	F	Operation enabling/disabling of the third work quadrant of the torque / speed plan. This function is available in DCREG4 only. See also figure in the OPERATION QUADRANTS chapter. **0:Enabled**. The third quadrant is enabled. **1:Disabled**. The third quadrant is disabled.

7.3.19 C063: Fourth Quadrant Selection

C063 4thQ-FwdReg		
***	P	C063 – 4thQ-FwdReg (used in DCREG4 only)
	R	0 … 1
	D	DCREG4: 0 DCREG2: 1 (not used)
	F	Operation enabling/disabling of the fourth work quadrant of the torque / speed plan. This function is available in DCREG4 only. See also figure in the OPERATION QUADRANTS chapter. **0:Enabled**. The fourth quadrant is enabled. **1:Disabled**. The fourth quadrant is disabled.

7.3.20 C070: FEEDBACK SELECTION

C070 nFdbkSelect		
***	P	C070 - nFdbkSelect
	R	0 ... 4
	D	2
	F	This parameter selects the signal to be used as a feedback. **0:Tach 8÷25 V.** The signal used as a speed feedback is included in the 8 ... 25V voltage range; the voltage is supplied by a tacho and detected via terminal 20. **1:Tach 25÷80 V.** The signal used as a speed feedback is included in the 25 ... 80V voltage range; the voltage is supplied by a tacho and detected via terminal 22. **2:Tach 80÷250 V.** The signal used as a speed feedback is included in the 80 ... 250V voltage range; the voltage is supplied by a tacho and detected via terminal 23. **3:Encoder.** The signal used as a speed feedback is an encoder output detected via terminals 14 and 16, or via 9-pole D-connector CN2. **4:Armature.** The signal used as a voltage feedback is the drive voltage output; in case of a motor, the voltage feedback is the armature voltage. When the drive operates according to an armature feedback with a resistive load, parameter C051 *(CurrLoopSel)* should be set to the *0:PI operating* default value.

NOTE

In case of a tacho or encoder feedback, the max. motor speed with a speed reference equal to 100% is programmed through parameter P010 *(nFdbkMax)*; in case of an armature feedback, the max. voltage with a speed reference equal to 100% is programmed through parameter P011 *(VarmMax)*.

7.3.21 C072: ENCODER PULSES/REV

C072 EncoderPls		
***** pls/R	P	C072 - EncoderPls
	R	100 ... 10000 pulses/rev
	D	1024 pulses/rev
	F	This parameter conveys information about the encoder pulses/rev.

WARNING

The values set in parameter C072 and parameter P010 should allow product C072•P010 **not to exceed 102.400kHz (e.g. 1024 pulses/rev for 6000 RPM max.)** in order to avoid any drive failure.

7.3.22 C074: TACHO TRANSDUCTION RATIO

C074 Tach Volts		
*** V/1000 RPM	P	C074 - TachoConst
	R	5 ... 120 V /1000 RPM
	D	60 V / 1000 RPM
	F	This parameter conveys information about the transduction ratio of the tacho used for the speed feedback according to a V / 1000 RPM unit of measure.

WARNING

The values set on parameter C074 and parameter P010 should allow product C074•P010 **not exceed 25V if C070 = 0, 80V if C070 = 1, 250V if C070 = 2**. Otherwise, this will cause drive speed control failure.

7.3.23 C090: ALARMAUTORESET NUMBER

C090 AutoReset		
** times	P	C090 - AutoReset
	R	0 ... 10 times
	D	0 times
	F	This parameter programs the max. number of autoreset retries of an alarm (autoreset) which may be performed (when 2s have passed since the removal of the cause generating the alarm) when the minimum time between two resetting procedures - set on parameter C091 *(AutoResTime)* - has not passed. Set C090 = 0 to disable the function.

7.3.24 C091: RESETTIME OF AUTORESETNUMBER

C091 AutoResTime		
*** sec	P	C091 - AutoResTime
	R	1 ... 999 s
	D	300 s
	F	This parameter determines, in seconds, the minimum time interval that should pass from the last reset, before setting the autoreset counter to zero. The counter may be cleared only by a manual reset when the drive has performed all the resets programmed on parameter C090 and the cause generating again an alarm doesn't disappear before the mentioned time interval has passed.

7.3.25 C092: POWERONRESET

C092 PwrOnReset		
***	P	C092 - PwrOnReset
	R	0 ...1
	D	0
	F	This parameter determines whether no memorization should be performed in the EEPROM after an alarm trip, so that the alarm will not be displayed at the following drive power on (if, of course, the alarm cause has been removed). **0:No.** The alarm trip is stored and displayed when the drive is powered on again. **1:Yes.** The alarm trip is not stored, so it is not displayed when the drive is powered on again.

7.3.26 C093: AUTORESET AFTER MAINS FAILURE

C093 MainsReset		
***	P	C093 - MainsReset
	R	0 ... 1
	D	1
	F	This parameter determines whether the drive, in case of a mains break (regardless of its duration) concerning the power section, is able to perform an unlimited number of alarm autoresets, in such a way that by restoring the power supply no alarm is kept stored. As a rule the generating alarm is A007 (*MainsFailure*), though it may sometimes happen that alarms A006 (*Unstable Frequency*), A012 (*Frequency out of Range*), A013 (*Missing Synchronization*) or A017 (*Mains Undervoltage*) have tripped. **0:No.** When the power supply is restored after a mains break on the power section, one of the above mentioned alarms is kept stored. **1:Yes.** When the power supply is restored after a mains break on the power section, no alarm trip is kept stored.

7.3.27 C094: STARTSAFETY

C094 StartSafety		
***	P	C094 - StartSafety
	R	0 ... 1
	D	0
	F	When the cause of the alarm trip has disappeared and a manual or automatic reset of the alarm has been performed, this parameter determines whether a safety preventing the drive to automatically and immediately restart should be enabled. Of course, this function is active only if the device is actually able to restart (no alarm detected, power section properly supplied, *ENABLE* and *START* digital inputs closed). **0:No.** Device self-start enabled when no alarm conditions are detected, after the reset or when the power supply is restored. **1:Yes.** The device is not allowed to restart by itself when no alarm conditions are detected, after the reset or when the power supply is restored. By contrast, it may be restarted only after the *ENABLE* digital input temporary activation and deactivation. In that case, warning W004 is displayed (Open-Close ENABLE to run).

7.3.28 C100: LOCAL / MIXED SELECTION ENABLING

C100 LocRemSel		
***	P	C100 - LocRemSel
	R	0 ... 1
	D	0
	F	This parameter allows the drive switching from the MIXED mode (i.e. from terminal board, serial communication, field bus or keypad) to the LOCAL mode only (i.e. from keypad only) and vice versa, by simultaneously pressing the "^" and "SAVE" keys. **0:Enabled.** Switching (obtained by pressing the two above mentioned keys simultaneously) enabled. **1:Disabled.** Switching (obtained by pressing the two above mentioned keys simultaneously) disabled. This parameter may be used to avoid an accidental switching of the drive operation trough the keypad.

NOTE

In any operating mode, the drive running procedure always requires the *ENABLE* contact closing on terminal 24.

7.3.29 C101: DELAY FROM STARTING ENABLING

C101 PwrOnTime		
**** sec	P	C101 - PwrOnTime (**from SW Vers. D3.09 only**)
	R	0.00 ... 10.0 s
	D	10.0 s
	F	Only if the inductive load type is selected, this parameter indicates the delay time (in seconds) from the application of supply voltage to the control section before the first start command is sent.

7.3.30 C102: ZEROINGTIME

C102 ZeroingTime	P	C102 - ZeroingTime (**from SW Vers. D3.09 only**)
***** msec	R	30.00 ... 3000. ms
	D	200.0 ms
	F	Only if the inductive load type is selected, this parameter indicates the time period (in milliseconds) after which both bridges are off when reversing.

7.3.31 C103: EMERGENCY STOP

C103 EmergStop	P	C103- EmergStop
***	R	0 ...1
	D	1
	F	This parameter defines the operating mode of the "STOP" key. **0:Included.** Regardless of the command sources that have been selected, pressing the "STOP" key determines the *START* digital input contact disabling. Speed will therefore decrease according to the ramp set in parameter P034 *(RampStopPos)* or P035 *(RampStopNeg)*, depending on the reference polarity. To restart the device, open and close the *START* digital input. In that case, warning W005 (*Open-Close START to run*) is displayed. **1:Excluded.** This key is active when at least one of the selected sources for the command setting corresponds to *KeyPad*. For the interaction of this key with the *START* digital inputs coming from other sources, see the *Ref n* section in the BLOCK DIAGRAM chapter.

7.3.32 C105(106)(107)(108): SOURCE REFERENCE SELECTION 1(2)(3)(4)

C… RefSelx		C105(106)(107)(108) – RefSel1(2)(3)(4)
***	R	0 ...4
	D	C105: 1 C106: 0 C107: 0 C108: 0
	F	C105: Determines reference source n.1. C106: Determines reference source n.2. C107: Determines reference source n.3. C108: Determines reference source n.4. **0:Disabled**. This selection does not enable any reference source. **1:Terminal**. This selection enables the terminal board as a reference source. **2:UpDownRef**. This selection enables the internal Up / Down reference as a reference source. **3:Serial Link**. This selection enables the serial connection as a reference source. **4:FieldBus**. This selection enables the field bus as a reference source. The user may select max. four sources, therefore the *MainRef* may by equal to the sum of the references coming from all four available sources. If the same source is enabled by two or multiple selections, this corresponds to selecting this source only once.

WARNING

For each MIXED → LOCAL switching performed by simultaneously pressing the "∧" and "SAVE" keys, the values of the four parameters change as follows:
C105 → *2:UpDownRef*
C106 → *0:Disabled*
C107 → *0:Disabled*
C108 → *0:Disabled*
These parameters cannot be changed in LOCAL mode.

7.3.33 C110(111)(112): COMMAND SOURCE SELECTION 1(2)(3)

C… SeqSelx		C110(111)(112) – SeqSel1(2)(3)
***	R	0 ...4
	D	C110: 1 C111: 0 C112: 0
	F	C110: Determines command source n.1. C111: Determines command source n.2. C112: Determines command source n.3. **0:Disabled**. This selection does not enable any command source. **1:Terminal**. This selection enables the terminal board as a command source. **2:UpDownRef**. This selection enables the internal Up / Down reference as a command source. **3:Serial Link**. This selection enables the serial connection as a command source. **4:FieldBus**. This selection enables the field bus as a command source. The user may select max. three sources, therefore the *MainRef* may by equal to the sum of the references coming from all three available sources. If the same source is enabled by two or multiple selections, this corresponds to selecting this source only once.

WARNING

For each MIXED → LOCAL switching performed by simultaneously pressing the "∧" and "SAVE" keys, the values of the four parameters change as follows:
C110 → *2:KeyPad*
C111 → *0:Disabled*
C112 → *0:Disabled*
These parameters cannot be changed in LOCAL mode.

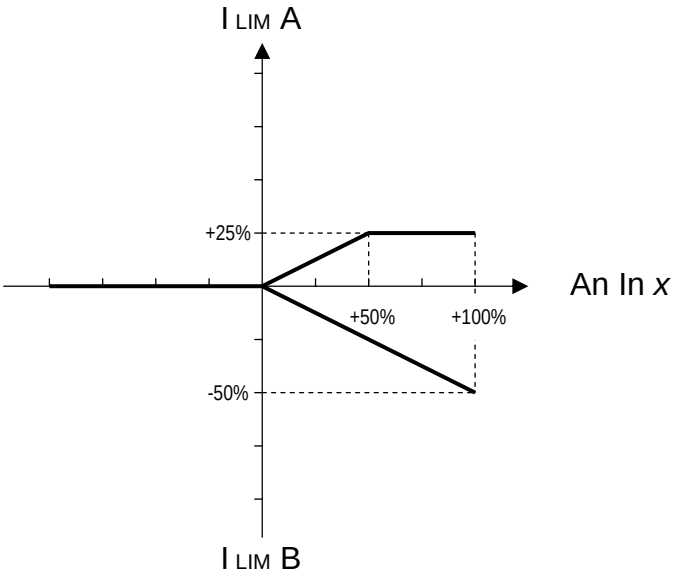
7.3.34 C120(121)(122): ANALOG INPUT 1(2)(3) CONFIGURATION

C... AnInxCfg		
***	P	C120(121)(122): - AnIn1(2)(3)Cfg
	R	0 ... 11
	D	0
	F	C120: It defines the configuration of programmable analog input 1 *(IN 1)* between terminals 11 and 13. C121: It defines the configuration of programmable analog input 2 *(IN 2)* on terminal 17. C122: It defines the configuration of programmable analog input 3 *(IN 3)* on terminal 19. **0:Excluded.** **1:n loop add.ref.** The reference to analog input *IN x* is an additional speed / voltage reference. **2:I loop add.ref.** The reference to analog input *IN x* is an additional current reference. **3:Ramps reduct.** The reference to analog input *IN x* is a signal for the decrease per cent of the four ramp times programmed through parameters P030 ... P033. **4:tUP+ reduction.** The reference to analog input *IN x* is a signal for the decrease per cent of the rise ramp time of positive reference P030. **5:tUP- reduction.** The reference to analog input *IN x* is a signal for the decrease per cent of the rise ramp time of negative reference P032. **6:tDN+ reduction.** The reference to analog input *IN x* is a signal for the decrease per cent of the fall ramp time of positive reference P031. **7:tDN- reduction.** The reference to analog input *IN x* is a signal for the decrease per cent of the fall ramp time of negative reference P033. **8:Ext. curr.lim.** The reference to analog input *IN x* is a current limit external reference for bridge A only (DCREG2) or for both bridges A and B (DCREG4). **9:BrdgA ext.lim**. The reference to analog input *IN x* is a current limit external reference for bridge A only in DCREG4. (This function is available for DCREG4 only). Do no set it for DCREG2. **10:BrdgB ext.lim**. The reference to analog input *IN x* is a current limit external reference for bridge B only in DCREG4. (This function is available for DCREG4 only). Do no set it for DCREG2. **11:Fld. curr.lim**. The reference to analog input *IN x* is a signal for the decrease per cent of the motor rated current programmed through parameter C010 (*IFldNom*).

NOTE

As for the external current limit, at 100% of the internal signal (M010, M011 or M012) and if we suppose that limit parameters P050 ... P057 are programmed for 100%, then the current limit will be the one set by C000 motor rated current, eventually reduced by hardware limit (IMAX[T2]).
On the other hand, if the internal signal is under 100%, the current limit will proportionally decrease. All this is shown in the diagram, where the polarity to be applied to the external limit signal of both bridges is assumed to be positive (par. P126(129)(132) (*AnInxPol*) at*1:Positive only*), and C000=50%, P050=50% and P051=100%.

If more than one analogic input has been setup as an external current limit, then the one with minimum limit resulting in absolute value is considered.



NOTE

As for the ramp time and the motor field rated current external limit, at 100% of the internal signal (M010, M011 or M012) the above-mentioned values will correspond to the times internally set through parameters P030 ... P033 and par. C010 respectively.
On the other hand, if the internal signal is under 100%, said values will proportionally decrease. P038 and P039 rounding will be decreased by the same value per cent as well.
In general, for the external decrease function, the signal applied to the analog input may have any **polarity**.
If multiple analog inputs have been configured as an external decrease, the analog input with the min. value will prevail.

7.3.35 C130(131)(132)(133)(134)(135): DIGITAL INPUT 1(2)(3)(4)(5)(6) CONFIGURATION

C... MDIxCfg	P	C130(131)(132)(133)(134)(135) - MDI1(2)(3)(4)(5)(6)Cfg
***	R	0 ... 20 (**from SW Vers. D3.09**; 0 ... 18 **up to SW Vers. D3.07**)
	D	C130: 0 C131: 12 C132: 13 C133: 1 C134: 4 C135: 5
	F	C130: It indicates the configuration of programmable digital input 1 *(MDI 1)* (terminal 28 if the terminal board is selected). C131: It indicates the configuration of programmable digital input 2 *(MDI 2)* (terminal 30 if the terminal board is selected). C132: It indicates the configuration of programmable digital input 3 *(MDI 3)* (terminal 32 if the terminal board is selected). C133: It indicates the configuration of programmable digital input 4 *(MDI 4)* (terminal 34 if the terminal board is selected). C134: It indicates the configuration of programmable digital input 5 *(MDI 5)* (terminal 36 if the terminal board is selected). C135: It indicates the configuration of programmable digital input 6 *(MDI 6)* (terminal 38 if the terminal board is selected). **0:Reset.** When the input closes, it enables deleting the alarm previously stored. This is equivalent to simultaneous pressing the "PROG" and "SAVE" keys. **1:Preset Speed A.** When the input closes, it selects - in conjunction with other digital inputs programmed with the *2:Preset Speed B* and *3:Preset Speed C* functions - a preset run reference among all references programmed in parameters P211 ... P217, according to the matching table contained in the section relating to said parameters. **2:Preset Speed B.** When the input closes, it selects - in conjunction with other digital inputs programmed with the *1:Preset Speed A* and *3:Preset Speed C* functions - a preset run reference among all references programmed in parameters P211 ... P217, according to the matching table contained in the section relating to said parameters. **3:Preset Speed C.** When the input closes, it selects - in conjunction with other digital inputs programmed with the *1:Preset Speed A* and *2:Preset Speed B* functions - a preset run reference among all references programmed in parameters P211 ... P217, according to the matching table contained in the section relating to said parameters. **4:Clim.** When the input closes, it enables decreasing the actual current limit for both bridges according the value per cent programmed in P058 *(Clim)*. **5:Reverse**. When the input closes, it reverses polarity for the *Ref n* reference applied to the ramps (including the preset run references and the internal jog references), and for the references on auxiliary inputs, provided that they are configured as speed references. **6:Slave Enabled.** When the input closes, it disables the speed loop; the same function is obtained if parameter C050 is programmed as *3:Iref=Vref*. As a consequence, the current reference is supplied by the *Main Ref* or by one of the preset run references or by one of the internal jog references, summed to references *IN 1*, *IN 2* and *IN 3*, provided that they have been configured as additional current references. However, the current reference enter the control loop with no ramp or rounding, even though they have been programmed in parameters P030 ... P039.

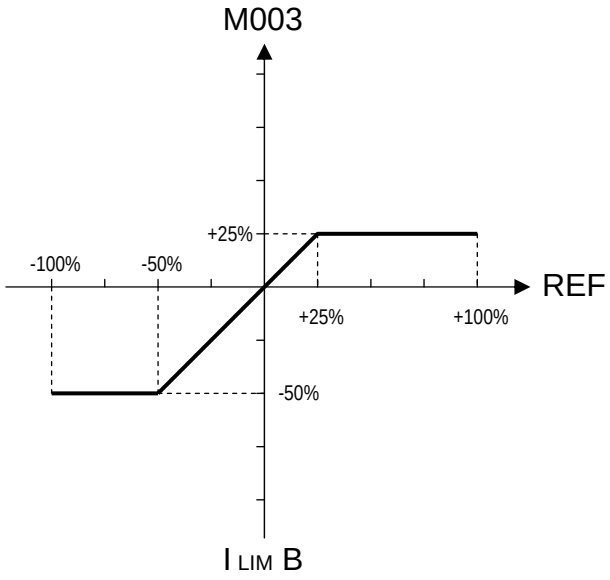
	F	**7:Ramps Disabled.** When the input closes, it resets the ramp times programmed in parameters P030 ... P035 as well as any rounding value programmed in parameters P038 and P039. When the ramp times and rounding values are to be brought back to their original values, the digital input is to be opened before sending the new speed reference; if not, the ramp programmed will not take place. **8:Second ParmSet.** If a motor constantly operates under different conditions (such as mechanical time constants, gear ratio, inertial moments and so on) that require separate control parameters for the speed loop, the input closing enables switching from the parameter standard values to its alternative values. Particularly, for the proportional gain, integral time, adapted proportional gain, adapted integral time, the values programmed in P070 ... P074 will switch to the values programmed in P076 ... P080 respectively. For the first two parameters, the speed auto tuning will calculate the standard or alternative values depending on the state of the digital input concerned. **9:MinSpdDisabled.** If you set parameter P012 *(SpdDmndPol)* to *1:Positive only* or *2:Negative only*, when the input closes this function will disable the min. speed positive reference programmed in parameter P014 *(nMinPos)* or the min. speed negative reference programmed in parameter P016 *(nMinNeg)*. **10:Ext Failure 1**. Alarm A020 trips when the input opens. **11:FldFrcEnabled.** When this input is closed, it increases the field current to the value possibly set at parameter C017 (*FldFrcLevel*) and according to the time programmed at parameter C018 (*FldFrcTime*). **12:JogA.** When this input is closed, it selects, together with another possible digital input programmed with function *13:JogB*, a jog reference among the ones programmed on parameter P222 ... P224, according to the corresponding matching table. **13:JogB.** When this input is closed, it selects, together with another possible digital input programmed with function *12:JogA*, a jog reference among the ones programmed on parameter P222 ... P224, according to the corresponding matching table. **14:Up**. When this input closes, it increases the value of the *UpDownRef* internal reference with respect to the ramp set in par. P040 (*UpDnRefRamp*). This is true if at least one of parameters C105 ... C108 is set to *2:UpDownRef*. See also the MOTOR POTENTIOMETER chapter. **15:Dn**. When this input closes, it decreases the value of the *UpDownRef* internal reference with respect to the ramp set in par. P040 (*UpDnRefRamp*). This is true if at least one of parameters C105 ... C108 is set to *2:UpDownRef*. See also the MOTOR POTENTIOMETER chapter. **16:UpDnRefReset**. When the input closes, it sets to zero - with no ramps - the value of the *UpDownRef* internal reference. See also the MOTOR POTENTIOMETER chapter. **17:Ext Failure 2**. When the input opens, alarm A029 trips. **18:Ext Failure 3**. When the input opens, alarm A030 trips. **From SW Vers. D3.09**: **19:IN Timer A**. When input closes, signal is reproduced to the configurable digital output set as *12:OUT Timer A*. Signal is reproduced based on timing set for *MDO1(2)(3)(4)(5)OnDelay* and *MDO1(2)(3)(4)(5)OffDly* and based on logics set for *MDO1(2)(3)(4)(5)Logic*. **20:IN Timer B**. When input closes, signal is reproduced to the configurable digital output set as *13:OUT Timer B*. Signal is reproduced based on timing set for *MDO1(2)(3)(4)(5)OnDelay* and *MDO1(2)(3)(4)(5)OffDly* and based on logics set for *MDO1(2)(3)(4)(5)Logic*.

(for MDIxCfg set at **6:Slave Enable**). With respect to the external setting of a current reference, when the internal signal percentage is increased (M014, M010, M011 or M012) the current reference percentage - displayed by par. M003 *(Iref)* - will increase accordingly, until the limit current value is reached. Beyond that value, the current reference set will be kept constant.

NOTE

This is shown in the figure by side, where the current reference external setup is assumed to be defined by the *REF* main analog input and C000=50%, P050=50% and P051=100%.

With two drives configured in MASTER / SLAVE mode, as the reference standard level supplied by the MASTER drive is 5V at the nominal current (M003 = 100%), if also the SLAVE drive must supply its nominal current - with said reference at *REF* main reference between terminals 5 and 7 - gain P125 *(IrefGain)* is to be set at 200%.



NOTE

If you set several digital inputs to the same configuration, close at least one of the relevant digital inputs to enable that configuration.

7.3.36 C141: ALARM A016/017 TRIP DELAY

C141 A016/7 (VAC)	P	C141 - A016/7(VAC)
**** ms	R	0.00 ... 2000 ms
	D	1000 s
	F	This parameter sets, in milliseconds, the delay time of the drive locking when either alarm A016 *(Mains OverVoltage)* or A017 *(Mains UnderVoltage)* trips. For alarm A017 (*Mains UnderVoltage*), the delay set through this parameter is active only if the supply voltage does not decrease under 3/4 of the threshold value (85% or 80% of the rated value) and if no regeneration braking is in progress. In any other case, the alarm will immediately trip.

7.3.37 C142: ALARM A027 TRIP DELAY

C142 A027 (SLink)		
**** s	P	C142 - A027(SLink)
	R	1.00 ... 100. s
	D	1.00 s
	F	When the serial communication is selected as a reference or command source, this parameter sets, in seconds, alarm A027 (*Serial Link Failure*) trip delay, provided that no valid message has been sent.

7.3.38 C143: ALARM A028 TRIP DELAY

C143 A028 (FBus)		
**** s	P	C143 - A028(FBus)
	R	1.00 ... 100. s
	D	1.00 s
	F	When the field bus is selected as a reference or command source, this parameter sets, in seconds, alarm A028 (*FieldBus Failure*) trip delay, provided that no valid message has been sent.

7.3.39 C150: ALARM A001 TRIP DISABLING

C150 A001 (Fld)		
***	P	C150 - A001 (Fld)
	R	0 ... 1
	D	0
	F	It inhibits alarm A001 *(Field Failure)* trip. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled.

7.3.40 C151: ALARM A004 TRIP DISABLING

C151 A004 (Load)		
***	P	C151 - A004 (Load)
	R	0 ... 1
	D	0
	F	It inhibits alarm A004 *(Load Loss)*. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled.

7.3.41 C153: ALARM A006 TRIP DISABLING

C153 A006 (fUnst)		
***	P	C153 - A006(fUnst)
	R	0 ... 1
	D	0
	F	It inhibits alarm A006 *(Unstable Frequency)*. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled.

7.3.42 C154: ALARM A007 TRIP DISABLING

C154 A007 (Mains)		
*	P	C154 - A007(Mains)
	R	0 ... 1
	D	0
	F	It inhibits alarm A007 *(Mains Failure)*. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled.

7.3.43 C155: ALARM A008 TRIP MANAGEMENT

C155 A008 (nFdbk)		
***	P	C155 - A008(nFdbk)
	R	0 ... 2
	D	0
	F	This parameter manages alarm A008 *(Speed Feedback Failure)* trip. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled. **2:Switch to Varm.** The alarm is disabled, but a speed feedback loss will cause the automatic switching of the speed feedback from TACHO or ENCODER to ARMATURE feedback. If this happens, also warning W002 (*Speed Fdbk switched to Varm*) will trip. To reset it, disable the *ENABLE* digital input.

7.3.44 C156: ALARM A010 TRIP DISABLING

C156 A010 (ArmOV)		
***	P	C156 – A010(ArmOV)
	R	0 ... 1
	D	0
	F	This parameter inhibits alarm A010 (*Armature OverVoltage*) trip. **0:Included**. The alarm is enabled. **1:Excluded**. The alarm is disabled.

7.3.45 C157: ALARM A016/017 TRIP DISABLING

C157 A016/7 (VAC)		
***	P	C157 - A016/7(VAC)
	R	0 ... 1
	D	0
	F	It inhibits both alarm A016 *(Mains OverVoltage)* and A017 alarm *(Mains UnderVoltage)*. **0:Included.** The two alarms are enabled. **1:Excluded.** The two alarms are disabled.

7.3.46 C158: ALARM A027 TRIP DISABLING

C158 A027 (SLink)		
***	P	C158 - A027 (SLink)
	R	0 ... 1
	D	1
	F	It inhibits alarm A027 *(Serial Link Failure)* trip. **0:Included.** The alarm is enabled. **1:Excluded.** The alarm is disabled.

7.3.47 C159: ALARM A028 TRIP DISABLING

C159 A028 (FBus)		C159 - A028(FBus)
***	R	0 ... 1
	D	1
	F	It disables alarm A028 (*FieldBus Failure*) trip. **0:Included**. The alarm is enabled. **1:Excluded**. The alarm is disabled.

7.3.48 C160: SERIAL CONNECTION DRIVE ADDRESS

C160 DeviceID		C160 - DeviceID
# ***	R	#1 ... 247
	D	#1
	F	This parameter indicates the physical address identifying the DCREG drive in the MODBUS connection relating to the serial network which it is connected to (if any).

7.3.49 C161: SERIAL CONNECTION TRANSMISSION SPEED

C161 BaudRate		C161 - BaudRate
*** bps	R	1200 ... 128000 bps
	D	9600 bps
	F	This parameter expresses the serial connection transmission speed (baud rate) in bits per second. **1200.** The transmission speed is equal to 1200 bps. ... **128000**. The transmission speed is equal to 128000 bps.

7.3.50 C162: SERIAL CONNECTION PARITY CONTROL

C162 Parity		C162 - Parity
***	R	0 ... 2
	D	0
	F	This parameter indicates whether the parity control is enabled and specifies the type of control. **0:None.** No parity control is to be found. Each character ends with two STOP BITS. **1:Even.** The parity control is enabled. It is an “even” parity control (the data to be transmitted are added a bit, so the total number of “1” is even). Each character ends with a STOP BIT only. **2:Odd.** The parity control is enabled. It is an “odd” parity control (the data to be transmitted are added a bit, so the total number of “1” is odd). Each character ends with a STOP BIT only.

7.3.51 C163: Master Data Area Base Address

C163 BaseAddress		
# *****	P	C163 - BaseAddress
	R	# 0 ... 32767
	D	# 0
	F	This parameter indicates the correspondence between the drive data area and the master data area.

7.3.52 C164: Serial Time Out

C164 RTUTimeOut		
**** ms	P	C164 – RTUTimeOut
	R	0.00 … 2000 ms
	D	300. ms
	F	This parameter indicates, in milliseconds, the timeout of the drive (*time out*) while receiving an additional character, before considering the inquiry transmitted by the master a concluded message.

7.3.53 C165: Serial Response Delay

C165 Rx→TxDelay		
**** ms	P	C165 - Rx→TxDelay
	R	0.00 … 2000 ms
	D	0.00 ms
	F	This parameter concerns the *half duplex* transmission mode only, like the two-wire RS485 standard. It defines, in milliseconds, the delay time of the drive before its response to a master inquiry, to make sure that the latter has already switched to the listening mode.

7.3.54 C170: Load Type

C170 LoadType		
***	P	C170 - LoadType (**from SW Vers. D3.09**)
	R	0 ... 1
	D	0
	F	This parameter indicates the load type connected to the output terminals. **0:Motor**. Output terminals connected to the armature of a DC motor. **1:Inductance**. Output terminals connected to an electromagnet.

8 DIAGNOSTICS

8.1 ALARM PARAMETERS

These parameters are displayed on the *Status* page when an alarm trips; in this case, the equipment is simultaneously locked.
They are marked on the display with an **A** followed by the parameter number.

TRIP. Whenever a failure is detected, the micro controller operates both the keypad display and the two seven-segment displays of the control board. The code relating to an alarm is shown and the drive is then locked.
Delay and disabling. When both alarms A016 (*Mains Overvoltage*) and A017 (*Mains Undervoltage*) are tripped, i.e. the alarms of the out-of-tolerance mains value, their connection may be **delayed** with parameter C141. Similarly, alarm A027 (*Serial Link Failure*) and A028 (*FieldBus Failure*) may be delayed through parameters C142 and C143 respectively. The other alarms are characterized by an internal preset and fixed delay. Finally, the trip of a certain number of alarms may be **disabled** through parameters C150 ... 159.

STORAGE. When 0.5s have gone by after the display visualization and the device locking because of a failure, this condition is **stored** in the EEPROM, except when it occurs while the control section is not supplied.
Power-on autoreset. The storage in the EEPROM will **not** occur whenever **parameter C092** (*PwrOnReset*) is set to value *1:Yes*. By cutting out the control section supply, at the following drive power on, it will be ready to be restarted provided that the alarm cause has been removed.

DELETION. To allow the device restarting, it is necessary to reset (i.e. to delete) the tripped alarm. Of course, this alarm has to be no more present, i.e. the cause generating it must be removed.
Manual and Automatic Reset. A **manual** reset may be performed by simultaneously pressing the "PROG" and "SAVE" keys or by closing a digital input which had been programmed as *0:Reset*. Alternatively, you may program an **automatic** reset (autoreset) by setting any value different from zero on parameter **C090** (*AutoReset*). The drive performs then a complete autoreset when 2s have passed since the removal of the cause generating the alarm, said autoreset is repeated whenever the alarm is connected again and then the cause disappears: parameter C090 sets precisely the maximum number of autoreset operations which may be performed when the minimum time between a reset and the following one - preset on **parameter C091** (*AutoResTime*) - has not gone by.
If an autoreset has been programmed through parameter C090, it has no effect on alarms A011 (*L out of Range*), A014 (*R out of Range*), A015 (*AutoTune Error*), A018 (*AutoTune Interrupted*), A019 (*AutoTune Limitation*), A025 (*EEPROM WorkArea Failure*), A026 (*EEPROM BackupArea Failure*), A032 (*µC Reset*) and A033 (*Unknown Failure*).
Mains micro break. Especially for alarms A006 (*Unstable Frequency*), A007 (*Mains Failure*), A012 (*Frequency out of Range*), A013 (*Missing Synchronization*) or A017 (*Mains Undervoltage*) - i.e. the alarms which may typically trip after a mains micro break on power section - it is possible to program the autoreset with an unlimited number of autodeletions by means of **parameter C093**. This operation may be performed also without programming on parameter C090 the general autoreset for all the other alarms.

RESTART. Whenever the power section is live and the device is able to restart (no alarm detected, supply enabled on power section, both *ENABLE* and *START* digital inputs active), it may be restarted at once or soon after a temporary enabling and disabling of the *ENABLE* input, according to what has been programmed in parameter **C094** (*StartSafety*).
Similarly, also when the power section is constantly supplied, the value of this parameter may either enable the drive to be restarted or not once a manual or automatic reset has deleted an alarm storage, and the cause generating the alarm has disappeared.

8.1.1 A001: FIELD CURRENT FAILURE

A001 Field Failure	I S	A001 - Field Failure The alarm trips: a. When running, in case of a field current failure. b. Alternatively, during the current auto tuning if the field current has been detected. The field current detection control is made through the comparison between par. M018 (*Ifld*) and an internal threshold equal to 7.5% of the value of C010 (value of the nominal field current). This alarm may be disabled through parameter C150.

NOTE This alarm trips only when the drive is running. It trips after a 2s internal delay.

8.1.2 A002: HEATSINK OVERTEMPERATURE

A002 Heatsink Trip	I S	A002 - Heatsink Trip The contact relating to the thermo switch assembled in the drive heatsink is open, thus signalling that the max. allowable temperature has been exceeded.

NOTE When the thermo switch contact is closed, LED *SA* in control board ES800 (ES906) turns on.

NOTE After the connection of the mentioned alarm, some minutes should generally elapse before performing a reset.

8.1.3 A003: ARMATURE OVERCURRENT

A003 Armature OverCurrent	I S	A003 - Armature OverCurrent The instantaneous value (peak value) of armature overcurrent M004 *(Iarm)* has exceeded 200 % of the drive rated current, or 300 % of the drive rated current under overlimit conditions.

8.1.4 A004: LOAD LOSS

A004 Load Loss	I S	A004 - Load Loss The alarm trips: a. When one of the two connections to the load terminals is cut off. b. If the DC side fuse (if any) is blown. This alarm may be disabled through parameter C151.

8.1.5 A006: UNSTABLE MAINS FREQUENCY

A006 Unstable Frequency	I S	A006 - Unstable Mains Frequency The mains frequency voltage varies more than the max. allowable value, equal to 500ms between two mains periods. This alarm may occur only when the *ENABLE* digital input is active. Set disabling through parameter C153 and continuous autoreset through parameter C093.

8.1.6 A007: Mains Phase Failure

A007 Mains Failure	I S	A007 - Mains Failure Failure of one of the three mains phases, or more than one. This alarm may occur only when the *ENABLE* digital input is active. Set disabling through parameter C154 and continuous autoreset through parameter C093.

8.1.7 A008: Speed Feedback Failure

A008 Speed Fdbk Failure	I S	A008 - Speed Fdbk Failure The alarm trips: a. When the tacho (or encoder) connection is reversed. b. When the tacho (or encoder) connection is cut off. c. In case of the tacho (or encoder) failure. This alarm may be disabled through parameter C155.

8.1.8 A009: Field Overcurrent

A009 Field OverCurrent	I S	A009 - Field OverCurrent The value of field current M018 *(Ifld)* has exceeded the product of C010 • C017 (value of the rated field current increased by the value percent set with the *boost*) for more than 15%. For the alarm trip, the *ENABLE* digital input must be active. The alarm trip is subject to a 10s internal delay. When this alarm trips, the field current is cut out.

8.1.9 A010: Armature Overvoltage

A010 Armature OverVoltage	I S	A010 - Armature OverVoltage The value of armature voltage M006 *(Varm)* has exceeded the max. allowable limit, which is linked with the rated value of the power section supply voltage; such limit is determined by the following product: C030•1.316. For instance, for a supply voltage nominal value equal to 400Vac, the alarm threshold will remain equal to 526Vdc. This alarm may be disabled through parameter C156.

8.1.10 A011: Auto Tuning Inductance out of Range

A011 L out of Range	I S	A011 - L out of Range The inductance corresponding to equivalent inductive drop P104 *(LdI/dt Pred)* resulting from the current auto tuning is not included in the allowable range.

8.1.11 A012: Mains Frequency out of Range

A012 Frequency out of Range	I S	A012 - Frequency out of Range Frequency M008 *(MFreq)* of the mains is over 70 Hz or is under 40 Hz. This alarm occurs only when the ENABLE digital input is activated. Set continuous autoreset through parameter C093.

8.1.12 A013: SYNCHRONIZATION FAILURE

A013 Missing Synchronization	I S	A013 - Missing Synchronization Failure of the circuits supplying the synchronizing signals of the mains three-phase voltage. This alarm may trip only when the *ENABLE* digital input is active. Set continuous autoreset through parameter C093.

8.1.13 A014: AUTOTUNING RESISTANCE OUT OF RANGE

A014 R out of Range	I S	A014 - R out of Range The resistance corresponding to equivalent resistive drop P103 *(RxI Pred)* resulting from the current auto tuning is not included in the allowable range.

8.1.14 A015: TORQUE DURING CURRENT AUTOTUNING

A015 AutoTune Error	I S	A015 - AutoTune Error During the current auto tuning stage (P001=1), the motor torque allows the motor to rotate at M001 *(nFdbk)* value higher than approx. 1.5%, due to any residual magnetism, even if the field is off. This alarm may also occurs if during the armature resistive drop autotuning (P001=3), the motor torque allows it to rotate at M001 *(nFdbk)* speed higher than approx. 1.5% in tacho or encoder feedback mode, or higher than 10% in encoder feedback mode, because of any residual magnetism, even if the field is off. In this case, it is necessary to **lock mechanically** the motor to perform the automatic calibration.

8.1.15 A016: MAINS OVERVOLTAGE

A016 Mains OverVoltage	I S	A016 - Mains OverVoltage Value M009 of power section mains voltage *(Vmains)* has exceeded the **lowest** limit between the following values: **1)** the maximum voltage to be applied (factory-set) increased by 10%. **2)** The rated voltage (C030) increased by 20%. This alarm may trip only when the ENABLE digital input is active. It may be delayed through parameter C141 and disabled through parameter C157.

8.1.16 A017: MAINS UNDERVOLTAGE

A017 Mains UnderVoltage	I S	A017 - Mains UnderVoltage Value M009 of power section mains voltage *(Vmains)* is under the rated voltage limit (C030) for a value equal to 15% in case of drives which are able to regenerate mains energy (2nd and/or 4th quadrant enabled). Otherwise, it proves a 20% decrease in case of drives which are **not** able to regenerate mains energy (2nd and 4th quadrant disabled). This alarm may occur only when the *ENABLE* digital input is active. It may be delayed through parameter C141 and disabled through parameter C157. Set continuous autoreset through parameter C093. The alarm delay (if any) set through par. C141 is active only if the supply voltage is not under 3/4 of the threshold value (85% or 80% of the rated value) and if no regenerative braking is in progress. In any other case, the alarm will immediately trip.

8.1.17 A018: AUTOTUNING INTERRUPTED

A018 AutoTune	I	A018 - AutoTune Interrupted
Interrupted	S	The current autotuning stage has been interrupted due to the disabling of the *ENABLE* digital input.

8.1.18 A019: LIMITATION DURING SPEED AUTOTUNING

A019 AutoTune	I	A019 - AutoTune Limitation
Limitation	S	During the speed auto tuning stage, the drive current limit took place.

8.1.19 A020: EXTERNALALARM 1

A020 External	I	A020 - External Failure 1
Failure 1	S	The digital input configured by setting one of par. C130 ... C135 to *10:ExtFailure 1* is open.

NOTE

After the connection of the mentioned alarm, some minutes should generally elapse before performing a reset.

8.1.20 A021: MOTOR THERMAL PROTECTION TRIP

A021 Motor	I	A021 - Motor I^2t Trip
I2t Trip	S	Motor overtemperature. The motor I^2t trip depends on the value programmed in parameters C001 *(MotThrshold)* and C002 *(MotThConst)*.

NOTE

After the connection of the mentioned alarm, some minutes should generally elapse before performing a reset.

8.1.21 A022: DRIVE THERMAL PROTECTION TRIP

A022 Drive	I	A022 - Drive It Trip
It Trip	S	Drive overtemperature. The alarm trip depends on the drive factory-set values.

8.1.22 A023: FIELD WEAKENING MIN. CURRENT LIMIT

A023 Ifld	I	A023 – Ifld Underlimited
Underlimited	S	During the dynamic regulation in field regulation mode, the alarm trips if the field current may no longer decrease because it is locked by the min. value defined by par. C016 (*IfldMinLim*) when the motor speed increases. The current may not decrease below par. C016 value. This alarm - that may have a 500ms internal delay-may trip due to a too high value set in par. C016 or the motor excessive speed. This alarm resets the field current value. See also the FIELD REGULATOR chapter.

8.1.23 A024: EEPROM Missing or Blank

A024 Missing	I	A024 - Missing or blank EEPROM
or blank EEPROM	S	At the drive power on, the alarm trips: a. If EEPROM is missing. b. If EEPROM is not programmed. See also the PARAMETER COPY chapter.

WARNING This alarm **cannot** be deleted. Please contact ELETTRONICA SANTERNO.

8.1.24 A025: Wrong Parameters in EEPROM Work Area

A025 EEPROM	I	A025 - EEPROM WorkArea Failure
WorkArea Failure	S	The content of some part in EEPROM work area is altered. In that case, the alarm is to be reset. Then, warning W006 or W008 will be displayed (see the relevant sections explaining what to do in that case). See also the PARAMETER COPY chapter.

8.1.25 A026: EEPROM Wrong Backup Parameters

A026 EEPROM	I	A026 - EEPROM BackupArea Failure
BackupArea Fail.	S	The content of some part in EEPROM work area is altered. In that case, the alarm is to be reset. Then, warning W007 or W009 will be displayed (see the relevant sections explaining what to do in that case). See also the PARAMETER COPY chapter.

8.1.26 A027: Serial Communication Failure

A027 Serial	I	A027 - Serial Link Failure
Link Failure	S	This alarm trips if the drive is not sent any valid message within the time set (*time out*) in par. C142 (*A027(Slink)*) when the drive is serial-connected to the master. The serial communication protocol selected for DCREG Series drives is the MODBUS type, according to the RTU transmission mode. The alarm may trip only if the serial communication is selected either as a possible reference source or as a possible command source, i.e. when at least one of par. C105 ... C108 (*RefSelx*) or C110 ... C112 (*SeqSelx*) is set at *3:Serial Link*. The alarm may be disabled through par. C158.

8.1.27 A028: Connection with Field Bus Failure

A028 FieldBus	I	A028 - FieldBus Failure
Failure	S	This alarm trips if the drive is not sent any valid message within the time set (*time out*) in par. C143 (*A028(FBus)*) when the drive is serial-connected to the master. The alarm may trip only if the bus field is selected either as a possible reference source or as a possible command source, i.e. when at least one of par. C105 ... C108 (*RefSelx*) or C110 ... C112 (*SeqSelx*) is set at *4:FieldBus*. The alarm may be disabled through par. C159.

8.1.28 A029: External Alarm 2

A029 External Failure 2	I S	A029 - External Failure 2 The digital input configured by setting one of par. C130 ... C135 at *17:Ext Failure 2* is open.

8.1.29 A030: External Alarm 3

A030 External Failure 3	I S	A030 - External Failure 3 The digital input configured by setting one of par. C130 ... C135 to *18:Ext Failure 3* is open.

8.1.30 A031: EEPROM Work Area Internal Data Altered

A031 Internal EEPROM Failure	I S	A031 - Internal EEPROM Failure When the equipment is turned on, the data that cannot be accessed by the user and that are contained in the EEPROM work area, are altered. See also the PARAMETER COPY chapter.

WARNING This alarm **cannot** be deleted. Please contact ELETTRONICA SANTERNO.

8.1.31 A032: Microcontroller Reset

A032 µC Reset	I S	A032 – µC Reset The execution of the drive control program has been cancelled by the micro controller itself, due to an invalid statement read by FLASH memory. In that case, you just need to reset the alarm.

8.1.32 A033: Unknown Failure

A033 Unknown Failure	I S	A033 - Unknown Failure An unknown alarm has been stored. In that case, you just need to reset the alarm.

8.1.33 Additional Alarms

POWER ON	This message usually pops up when control board ES800 (ES906) begins to supply the keypad for the first time. If the message does not disappear, this means that the keypad is live but the control board communication is shut off.
** ERROR# 1 ** LINK MISMATCH	Said message is displayed when a *time out* has elapsed. This means that the micro controller on the keypad has detected a communication break with control board ES800 (ES906).

In both cases, if *88* is displayed along with one of the two messages (or some other digits other than *00* for *Drive OK,* two blinking digits for an alarm or two fixed digits for a warning) control board ES800 (ES906) is probably damaged and shall be replaced.

8.2 WARNING PARAMETERS

The warning parameters are displayed in the *Status* page to indicate that a particular condition is taking place, although the drive is not locked.
Those parameters are marked by a W followed by the parameter number.

8.2.1 W002: SPEED FEEDBACK LOSS

W002 Speed Fdbk	I	W002 - Speed Fdbk switched to Varm
Switched to Varm	S	The drive has switched from tacho or encoder feedback to armature feedback. When the run contacts open, the warning disappears and the equipment restores the prior feedback type.

8.2.2 W003: HARDWARE LIMIT CURRENT NOT AT MAXIMUM VALUE

W003 Imax [T2]	I	W003 - Imax [T2] <100%
< 100%	S	Should the display show warning message W003 (*Imax [T2] <100%*), trimmer T2 of control board ES800 (ES906) has NOT been completely rotated clockwise. The trimmer indicates a hardware limitation of the armature current, which is also a wrong position. In fact it would cause a disagreement between the preset current limit values (shown by the display) and the maximum armature current to be obtained. Then, the latter value would be lower than that required. In this case it is necessary to turn trimmer T2 completely clockwise. Then, the warning disappears. Trimmer T2 is located on the right side of board ES800 (ES906), near the two 7-segment displays which can be seen through the small slot on the drive cover. The trimmer should be used by the Service personnel only, to temporarily reduce all the current limits during special test performances. After that, it should be reset to its maximum position.

8.2.3 W004: SAFE RESTART AFTER AN ALARM RESET

W004 Open-Close	I	W004 - Open-Close ENABLE to run
ENABLE to run	S	If par. C094 (*StartSafety*) is set to *1:Yes* and an alarm tripped has been manually or automatically reset, this warning indicates the steps to take for the drive restart. This warning disappears when the *ENABLE* input opens.

8.2.4 W005: RESTART AFTER AN EMERGENCY STOP FROM KEYPAD

W005 Open-Close	I	W005 - Open-Close START to run
START to run	S	If the equipment has been stopped by pressing the "STOP" key on the keypad (par. C103 (*EmergStop*) set on purpose), this warning indicates the steps to take for the drive restart. This warning disappears when the *START* input opens.

8.2.5 W006: BACKUP VALUES STORED IN RAM

W006 Backup parameters used	I S	W006 - Backup parameters used This warning may pop up after resetting Alarm A025 (*EEPROM WorkArea Failure*). It indicates that the backup parameter values have been loaded in the drive RAM. Provided that these values are the required values (i.e. provided that the P002 command → *2:WorkAreaBackup* has been sent after starting the equipment) the equipment could be normally started, but the alarm will be displayed when the equipment is started again. We recommend to rewrite the EEPROM work area by restoring the backup values through command P002 → *3:Backup Restore* (the warning disappears). See also the PARAMETER COPY chapter.

8.2.6 W007: DEFAULT VALUES STORED IN RAM

W007 Default parameters used	I S	W007 - Default parameters used This warning may pop up after resetting Alarm A026 (*EEPROM BackupArea Fail.*). It indicates that the default parameters have been stored in the equipment RAM. In general, this could cause some problems at the drive power on. The default values are then to be entered through the P002 → *1:DefaultRestore* command. In addition, if the equipment has been already started, in the EEPROM work area manually store the parameter values noted down at the end of the startup procedure. Always copy these values also in the backup area through the P002 → *2:WorkAreaBackup* command (the warning will disappear). See also the PARAMETER COPY chapter.

8.2.7 W008: WRONG PARAMETERS IN EEPROM WORK AREA

W008 EEPROM WorkArea Failure	I S	W008 - EEPROM WorkArea Failure This warning may pop up after resetting Alarm A025 (*EEPROM WorkArea Failure*). It indicates that the work area copy to the EEPROM work area has failed due to the alteration of the work area values. In general, the equipment may be normally started, but the warning should reappear when the drive is powered on again. Always enter the default values through the P002 → *1:DefaultRestore* command (the warning will disappear). In addition, if the equipment has been already started, in the EEPROM work area manually store the parameter values noted down at the end of the startup procedure. The P002 → *2:WorkAreaBackup* command may be resent. See also the PARAMETER COPY chapter.

8.2.8 W009: WRONG PARAMETERS IN EEPROM BACKUP AREA

W008 EEPROM WorkArea Failure	I S	W009 - EEPROM Backup Area Fail. This warning may pop up after resetting Alarm A026 (*EEPROM BackupArea Fail.*). It indicates that the work area copy to the EEPROM work area has failed due to the alteration of the work area values. In general, the equipment may be normally started, but we suggest that the default values be entered through the P002 → *1:DefaultRestore* if the values saved in the work area do not correspond to the values required. Then, manually store the parameter values noted down at the end of the startup procedure. Always copy these values in the backup area through the P002 → *2:WorkAreaBackup* command (the warning will disappear). See also the PARAMETER COPY chapter.

9 EMC CHARACTERISTICS AND INPUT FILTER

The drive EMC product standard refers to systems such as motors and converters as well as to their power supply and auxiliary circuits.
The standard defines the drive immunity and emission requirements with several tests to be applied to the equipment above:
- complete drives (PDS, power drive systems) composed of a drive, a motor, the transducers and sensors;
- CDM, complete drive module, composed of motorless drives;
- BDM, basic drive module, composed of both control and power section.

The standard also defines the **environments** and **commercial distribution modes** for which the drives are to be equipped with optional RFI filtering devices:

FIRST ENVIRONMENT	Includes civic and industrial users who are directly connected (with no intermediate transformers) to a low-voltage grid intended for domestic users.
SECOND ENVIRONMENT	Includes any industrial user other than those who are directly connected to a low-voltage grid intended for domestic users.

UNRESTRICTED DISTRIBUTION	The drive is also supplied to those users who do not have any EMC specific competence.
RESTRICTED DISTRIBUTION	The drive is supplied to those users who are EMC competent

As for RFI filters aimed at decreasing the **radio frequency disturbance**, the product standard includes different prescriptions depending on the environment where the drive is installed and on the commercial distribution system.

First environment

The appliances to be connected to a low-voltage grid also intended for civic users shall comply with the following restrictions:

UNRESTRICTED DISTRIBUTION, I < 25A

Size	Frequency band	Quasi-peak	Average
Low-voltage	0.15 ≤ f ≤ 0.5MHz	66 to 56dB(µV)	56 to 46dB(µV)
drive	0.5 ≤ f ≤ 5.0	56	46
(I < 25A)	5.0 ≤ f ≤ 30.0	60	50

Corresponds to the **limits for EN55011 gr.1 cl.B - EN55022 cl.B - VDE0875G**

UNRESTRICTED DISTRIBUTION, I ≥ 25A

Size	Frequency band	Quasi-peak	Average
Medium power	0.15 ≤ f ≤ 0.5 MHz	79dB(µV)	66dB(µV)
drive	0.5 ≤ f ≤ 5.0	73	60
(I ≥ 25A)	5.0 ≤ f ≤ 30.0	73	60

Corresponds to the **limits for EN55011 gr.1 cl.A - EN55022 cl.A - VDE0875N**

RESTRICTED DISTRIBUTION, I < 25A

Size	Frequency band	Quasi-peak	Average
Low-power	0.15 ≤ f ≤ 0.5MHz	79dB(µV)	66dB(µV)
drive	0.5 ≤ f ≤ 5.0	73	60
(I < 25A)	5.0 ≤ f ≤ 30.0	73	60

Corresponds to the **limits for EN55011 Gr.1 cl.A - EN55022 cl.A - VDE0875N**

RESTRICTED DISTRIBUTION, I ≥ 25A

Size	Frequency band	Quasi-peak	Average
Medium power	0.15 ≤ f ≤ 0.5MHz	79dB(µV)	66dB(µV)
drive	0.5 ≤ f ≤ 5.0	73	60
(I ≥ 25A)	5.0 ≤ f ≤ 30.0	73	60

Corresponds to the **limits for EN55011 Gr.1 cl.A - EN55022 cl.A - VDE0875N**

NOTE. Standards EN55011 and 55022 above define the limits and the measuring methods of the radio interference for some product categories.
Particularly:
EN55011/ IEC CISPR11: Limits and measuring methods of radio interference specifications for industrial, scientific and medical equipment (ISM).
EN55022/ IEC CISPR22: Limits and measuring methods of radio interference specifications generated by the equipment for information technology (ITE).
The limits for the disturbance of ISM equipment belonging to group 1 class A in EN55011 correspond to those for ITE equipment belonging to class A in EN55022. The limits for the disturbance of ISM equipment belonging to group 1 class B in EN55011correspond to those for ITE equipment belonging to class B in EN55022.

The following table shows the filter types to be used for any drive model.

NOTE If the actual power supply of the drive power section **exceeds** the filter nominal voltage, contact Elettronica Santerno.

Drive type	Filter type	Filter nominal voltage @ 50/60Hz	Filter nominal current @ Tamb=40°C	Filter code
DCREG.10	FX12	480V	3 x 12A	AC1710213
DCREG.20	FX20		3 x 20A	AC1710221
DCREG.40	FX50		3 x 50A	AC1710506
DCREG.70	FX65		3 x 65A	AC1710706
DCREG.100	FX90		3 x 90A	AC1710906
DCREG.150	FX120		3 x 120A	AC1711106
DCREG.180	FX150		3 x 150A	AC1711306
DCREG.250	FX210		3 x 210A	AC1711606
DCREG.350	FLTA-B 280T	460V	3 x 280A	AC1711805
DCREG.410	FLTA-B 360T		3 x 360A	AC1712005
DCREG.500	FLTA-B 500T		3 x 500A	AC1712405
DCREG.600	FLTA-B 500T		3 x 500A	AC1712405
DCREG.750	FLTA-B 600T	660V	3 x 600A	AC1712610
DCREG.900	FLTA-B 750T	460V	3 x 750A	AC1713015
DCREG.900	FLTA-B 750T	660V	3 x 750A	AC1713010
DCREG.1200	FLTA-B 1000T	460V	3 x 1000A	AC1713410

WARNING **Always connect AC/DC drives with RFI filters to low-voltage grids in residential areas, as they may produce radio frequency disturbance.**

NOTE **The filter is to be installed between three-phase switching inductance L and the drive input and is to be connected to bars L1-2-3. The wires connecting the filter to the drive are to be as short as possible.**

Second environment

The product standard does **not** state any limit for the equipment disturbances and radio frequency interferences for any equipment to be connected to a low-voltage industrial grid or to a civic grid which is not used for residential areas.

For the second environment, the product standard allows to use any **drive with no additional RFI filter**. However, the installer has to make sure that there is no electromagnetic compatibility trouble with the other appliances in the system.

10 USER'S PARAMETERS DIFFERENT FROM DEFAULT VALUES

PAR.	Setting	Default value	Modified value	PAR.	Setting	Default value	Modified value
P003	ProgLevel	0:Basic		P058	Clim	50 %	
P004	FirstPage	0:Status		P059	dI/dtMax	.40 %/µs	
P005	FirstParm	Select (→P006)		P060	OverLimA	100 %	
P006	MeasureSel	* * * * * * * *		P061	OverLimB	100 %	
P010	nFdbkMax	2500 RPM		P062	TFullOvLim	2.00 s	
P011	VarmMax	400 V (DCREG4) 460 V (DCREG2)		P070	KpSpeed	4.00	
P012	SpdDmndPol	0:Bipolar		P071	TiSpeed	1.00 s	
P013	nMaxPos	100 %		P073	KpSpdAdapt	4.00	
P014	nMinPos	0 %		P074	TiSpdAdapt	1.00 s	
P015	nMaxNeg	-100 %		P076	KpSpeed2	4.00	
P016	nMinNeg	0 %		P077	TiSpeed2	1.00 s	
P030	RampUpPos	0.000 s		P079	KpSpdAdapt2	4.00	
P031	RampDnPos	0.000 s		P080	TiSpdAdapt2	1.00 s	
P032	RampUpNeg	0.000 s		P082	AdaptCtrl	0:No	
P033	RampDnNeg	0.000 s		P083	Verr1	.500 %	
P034	RampStopPos	0.000 s		P084	Verr2	1.00 %	
P035	RampStopNeg	0.000 s		P085	TiRampScale	x 1	
P036	RampUpJog	0.000 s		P086	ArmatureCmp	100 %	
P037	RampDnJog	0.000 s		P087	VerrOffset	0.000 %	
P038	InitialRndg	0.0 s		P088	RxI	0 V	
P039	FinalRndg	0.0 s		P100	KpCurr	.200	
P040	UpDnRefRamp	10.00 s		P101	TiCurrDisc	1.30 ms	
P050	Ilim1A	100 %		P102	TiCurrCont	32.0 ms	
P051	Ilim1B	100 % (DCREG4) 0 % (DCREG2)		P103	RxI Pred	70.92 V	
P052	Ilim2A	100 %		P104	LdI/dt Pred	0.707 V	
P053	Ilim2B	100 % (DCREG4) 0 % (DCREG2)		P110	KpFld	2.00	
P054	Speed 1→2	100 %		P111	TiFld	.100 s	
P055	IlimHyper	100 %		P120	VrefPol	0:Bipolar	
P056	SpeedHyper1	100 %		P121	VrefBias	0.000 %	
P057	SpeedHyper2	100 %		P122	VrefGain	100.0 %	

PAR.	Setting	Default value	Modified value	PAR.	Setting	Default value	Modified value
P123	IrefPol	0:Bipolar		P178	MDO2OffDly	0.000 s	
P124	IrefBias	0.000 %		P179	MDO2Level	3 %	
P125	IrefGain	100.0 %		P180	MDO2Hyst	2 %	
P126	AnIn1Pol	0:Bipolar		P181	MDO2Logic	0:Normally Open	
P127	AnIn1Bias	0.000 %		P182	MDO3Cfg	2:Iarm Threshold	
P128	AnIn1Gain	100.0 %		P183	MDO3OnDelay	0.000 s	
P129	AnIn2Pol	0:Bipolar		P184	MDO3OffDly	0.000 s	
P130	AnIn2Bias	0.000 %		P185	MDO3Level	50 %	
P131	AnIn2Gain	100.0 %		P186	MDO3Hyst	2 %	
P132	AnIn3Pol	0:Bipolar		P187	MDO3Logic	0:Normally Open	
P133	AnIn3Bias	0.000 %		P188	MDO4Cfg	5:Drive Running	
P134	AnIn3Gain	100.0 %		P189	MDO4OnDelay	0.000 s	
P150	AnOut1Cfg	0:0 Volt		P190	MDO4OffDly	0.000 s	
P151	AnOut1Bias	0.000 %		P191	MDO4Level	5 %	
P152	AnOut1Gain	100.0 %		P192	MDO4Hyst	2 %	
P153	AnOut2Cfg	0:0 Volt		P193	MDO4Logic	0:Normally Open	
P154	AnOut2Bias	0.000 %		P194	MDO5Cfg	4:CurrLimitation	
P155	AnOut2Gain	100.0 %		P195	MDO5OnDelay	0.000 s	
P156	IOutPol	0:Bipolar (DCREG4) 1:Positive only (DCREG2)		P196	MDO5OffDly	0.000 s	
P157	AnOut1Pol	0:Bipolar		P197	MDO5Level	50 %	
P158	AnOut2Pol	0:Bipolar		P198	MDO5Hyst	2 %	
P170	MDO1Cfg	0:Drive OK		P199	MDO5Logic	0:Normally Open	
P171	MDO1OnDelay	0.000 s		P211	PresetSpd1	5.00 %	
P172	MDO1OffDly	0.000 s		P212	PresetSpd2	20.0 %	
P173	MDO1Level	50 %		P213	PresetSpd3	10.0 %	
P174	MDO1Hyst	2 %		P214	PresetSpd4	0.00 %	
P175	MDO1Logic	0:Normally Open		P215	PresetSpd5	-5.00 %	
P176	MDO2Cfg	1:Speed Threshold		P216	PresetSpd6	-20.0 %	
P177	MDO2OnDelay	0.000 s		P217	PresetSpd7	-10.0 %	

PAR.	Setting	Default value	Modified value	PAR.	Setting	Default value	Modified value
P221	JogSelect	0:Common Ramps		C072	EncoderPls	1024 pls/R	
P222	Jog1	5.00 %		C074	Tach Volts	60 V / 1000 RPM	
P223	Jog2	-5.00 %		C090	AutoReset	0 times	
P224	Jog3	0.00 %		C091	AutoResTime	300 s	
P230	AlfaMin	30.0° (DCREG4) 25.0° (DCREG2)		C092	PwrOnReset	0:No	
P231	AlfaMax	150.°		C093	MainsReset	1:Yes	
P240	LowPassCnst	0.00 ms		C094	StartSafety	0:No	
P250	UpDnRefPol	0:Bipolar		C100	LocRemSel	0:Enabled	
P251	UpDnRefMem	1:Yes		C101	PwrOnTime	10.0 s	
C000	Inom	100 %		C102	ZeroingTime	200.0 ms	
C001	MotThrshold	110 %		C103	EmergStop	1:Excluded	
C002	MotThConst	300 s		C105	RefSel1	1:Terminal	
C010	IfldNom	10.0 %		C106	RefSel2	0:Disabled	
C011	BaseSpeed	33 %		C107	RefSel3	0:Disabled	
C012	BaseVarm	1000 V		C108	RefSel4	0:Disabled	
C014	FldEcoLevel	10 %		C110	SeqSel1	1:Terminal	
C015	FldEcoDelay	240 s		C111	SeqSel2	0:Disabled	
C016	IfldMinLim	25 %		C112	SeqSel3	0:Disabled	
C017	FldFrcLevel	100 %		C120	AnIn1Cfg	0:Excluded	
C018	FldFrcTime	10. s		C121	AnIn2Cfg	0:Excluded	
C030	VmainsNom	400 V		C122	AnIn3Cfg	0:Excluded	
C050	SpdLoopSel	1:PI operating		C130	MDI1Cfg	0:Reset	
C051	CurrLoopSel	0:PI operating		C131	MDI2Cfg	12:JogA	
C052	FldLoopSel	0:PI operating		C132	MDI3Cfg	13:JogB	
C060	1stQ-FwdMot	0:Enabled		C133	MDI4Cfg	1:Preset Speed A	
C061	2ndQ-RevReg	0:Enabled		C134	MDI5Cfg	4:Clim	
C062	3rdQ-RevMot	0:Enabled (DCREG4) 1:Disabled (DCREG2)		C135	MDI6Cfg	5:Reverse	
C063	4thQ-FwdReg	0:Enabled (DCREG4) 1:Disabled (DCREG2)		C141	A016/7(VAC)	1000 ms	
C070	nFdbkSelect	2:Tach 80÷250 V		C142	A027(Slink)	1.00 s	

PAR.	Setting	Default value	Modified value	PAR.	Setting	Default value	Modified value
C143	A028(Fbus)	1.00 s		C159	A028(Fbus)	1:Excluded	
C150	A001 (Fld)	0:Included		C160	DeviceID	# 1	
C151	A004(Load)	0:Included		C161	BaudRate	9600 bps	
C153	A006(fUnst)	0:Included		C162	Parity	0:None	
C154	A007(Mains)	0:Included		C163	BaseAddress	# 0	
C155	A008(nFdbk)	0:Included		C164	RTUTimeOut	300. ms	
C156	A010(ArmOV)	0:Included		C165	Rx→TxDelay	0.00 ms	
C157	A016/7(VAC)	0:Included		C170	LoadType	0:Motor	
C158	A027(SLink)	1:Excluded					

EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.
Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italy

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE THREE-PHASE AC/DC CONVERTERS OF **DCREG2–DCREG4** TYPES,

AND RELATED ACCESSORIES,

TO WHICH THIS DECLARATION RELATES,

APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,

CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 61800-3 (1996-10)	Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods.
EN 55011 (1998-05)	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.
EN 61000-4-2 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test. Basic EMC Publication.
EN 61000-4-3 (1996-09)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test.
EN 61000-4-4 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test. Basic EMC Publication.
EN 61000-4-5 (1995-03)	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 5: Surge immunity test.

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 89/336/EEC AND SUBSEQUENT AMENDMENTS 92/31/EEC, 93/68/EEC AND 93/97/EEC.

PLACE AND DATE OF ISSUE
Casalfiumanese, 02/04/2001

SIGNATURE
Vice President.
Zamarini Ing. Sergio

EC DECLARATION OF CONFORMITY

Elettronica Santerno S.p.A.
Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italy

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE THREE-PHASE AC/DC CONVERTERS OF **DCREG2–DCREG4** TYPES,

TO WHICH THIS DECLARATION RELATES,

CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 60146-1-1 (1993-02)	Semiconductor converters. General requirements and line commutated converters. Part 1-1: Specifications of basic requirements.
EN60146-1-3 (1993-02)	Semiconductor converters. General requirements and line commutated converters. Part 1-3: Transformers and reactors.
IEC 664-1 (1992-10)	Insulation coordination for equipment within low-voltage systems. Part 1: Principles, requirements and tests.
EN 61800-1 (1998-02)	Adjustable speed electrical power drive systems. Part 1:Rating specifications for low voltage d.c. power drive systems.
EN 60204-1 (1997-12)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
EN 60204-1 Modifica 1 (1988-08)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.
EN 60529 (1991-10)	Degrees of protection provided by enclosures (IP Code).
EN 50178 (1997-10)	Electronic equipment for use in power installations.

FOLLOWING THE PROVISIONS OF LOW VOLTAGE DIRECTIVE 73/23/EEC AND SUBSEQUENT AMENDMENT 93/68/EEC.

LAST TWO DIGITS OF THE YEAR IN WHICH THE CE MARKING WAS AFFIXED: **99**

PLACE AND DATE OF ISSUE
Casalfiumanese, 02/04/2001

SIGNATURE
Vice President
Zamarini Ing. Sergio

MANUFACTURER'S DECLARATION

Elettronica Santerno S.p.A.
Via G. Di Vittorio, 3 - 40020 Casalfiumanese (BO) - Italy

AS MANUFACTURER

DECLARE

UNDER OUR SOLE RESPONSABILITY

THAT THE THREE-PHASE AC/DC CONVERTERS OF **DCREG2–DCREG4** TYPES,
TO WHICH THIS DECLARATION RELATES,
APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL,
CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

EN 60204-1 (1997-12)	Safety of machinery. Electrical equipment of machines. Part 1: General requirements.
EN 60204-1 Modifica 1 (1988-08)	Electrical equipment of industrial machines. Part 2: Item designation and examples of drawings, diagrams, tables and instructions.

AND MUST NOT BE PUT INTO SERVICE UNTIL THE MACHINERY INTO WHICH IT IS TO BE INCORPORED HAS BEEN DECLARED IN CONFORMITY WITH THE PROVISIONS OF MACHINERY DIRECTIVE 89/392/EEC AND SUBSEQUENT AMENDMENTS 91/368/EEC, 93/44/EEC AND 93/68/EEC.

PLACE AND DATE OF ISSUE
Casalfiumanese, 02/04/2001

SIGNATURE
Vice President.
Zanarini Ing. Sergio